EIGHTEENTH ANNUAL MOTOR NUMBER

SCIENTIFIC AMERICAN

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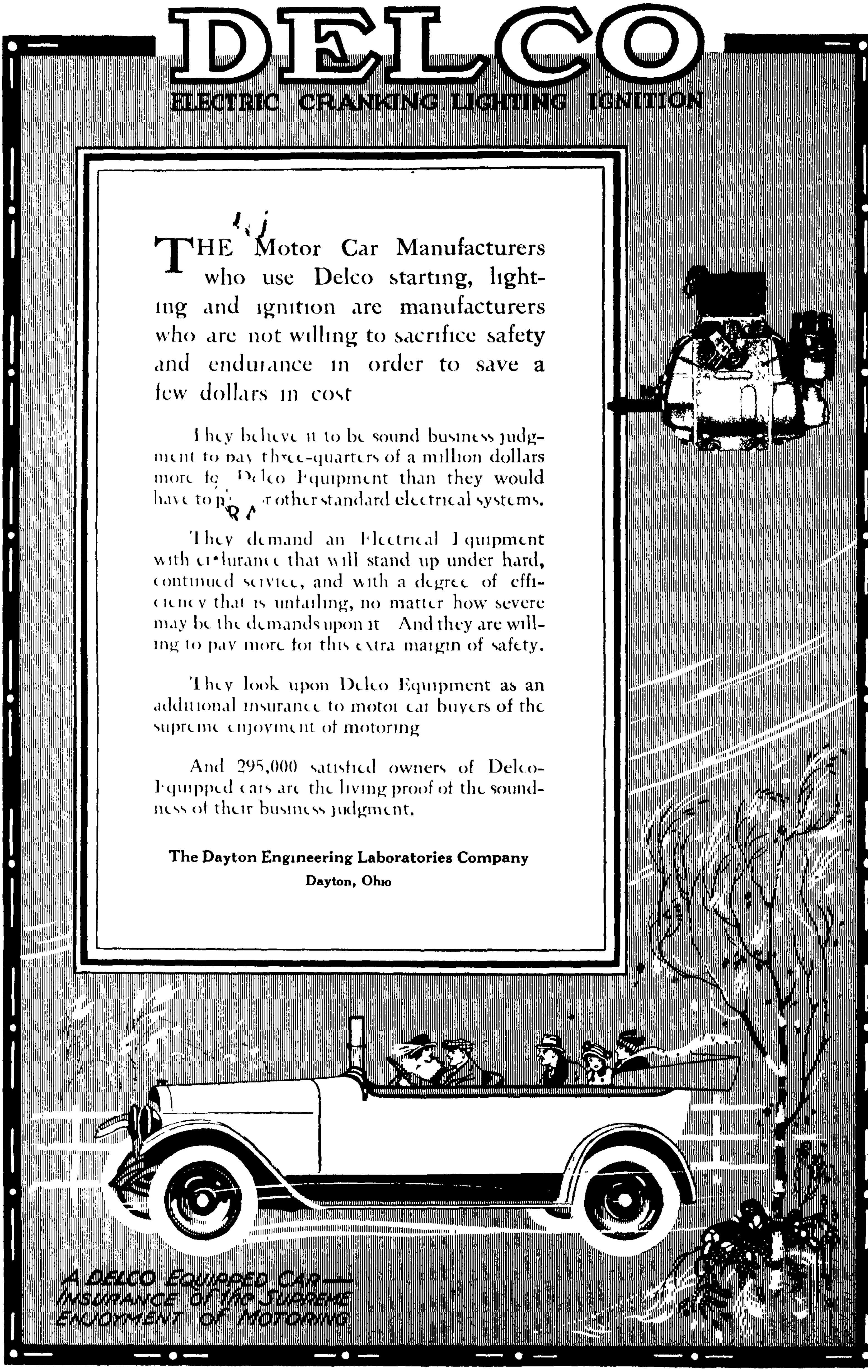
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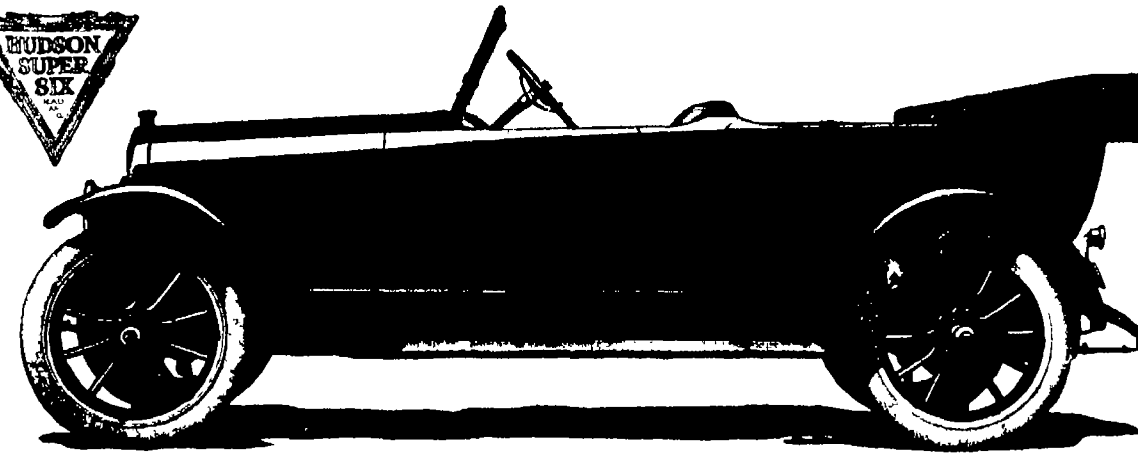

7-Passenger Phaeton, $1375 at Detroit. Five other body styles

We Now Present the

Hudson Super-Six

Patented by Hudson December 28 1915

76 Horsepower—An Added 80%, Without Any Added Size

Officially Breaking All Stock Car Records Up to 100 Miles
Also All Stock Car Records for Quick Acceleration

100 miles in 80 min, 21 4 sec, averaging 74 67 miles per hour, with driver and passenger

The previous best record of 72 49 was made by a car with more cylinders, more cylinder capacity and driver only

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During this speed trial laps were made at 76 75 miles per hour

From standing start to 50 miles per hour in 16 2 seconds

All these records made with same stock car using same motor at Sheepshead Bay Speedway in November under American Automobile Association supervision

The most powerful stock motor per cubic inch displacement which the world has ever known

Mark what those records mean

No other stock car in history has done what this car has done No other like size motor has developed such power

A car almost twice better than the best of former Sixes. Which has outrivaled Eights and Twelves.

That is what Hudson engineers present in this marvelous Super Six. And, because of Hudson patents, we control it.

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The Hudson Six-40 of last year stood first among Sixes Its matchless performance made it the pattern type It quadrupled Hudson sales in two years.

But the Super-Six excels it by 50 per cent in high motor speed capacity It excels it 80 per cent in power Yet the cylinder size is identical Lightness and economy are retained All this increase —this 80 per cent—comes through wiping out vibration.

AN ENORMOUS RESERVE

The Hudson Super-Six develops 76 horsepower That means an enormous reserve. It enables you to creep on high gear, to pick up quickly, to mount hills without effort, to avoid changing gears.

And it all comes through lack of vibration. So it brings with it bird-like motion. The motor is so quiet that one almost forgets it. The car seems to move by magic.

OLD TYPES DISCARDED

This Super-Six invention led us to stop production on the former Hudson at the zenith of our success We lost thousands of sales in consequence

It led us to cease experiments with Eights and Twelves, because the Super-Six excelled them.

It led us to double our factory to meet a doubled demand, at a cost of $1 500 000 And to buy materials for $42,000,000 worth of these new cars before the first Super-Six appeared

For this car means Hudson supremacy, over all other cars and types Any man who knows it will choose it if he buys a high-grade car Also many a man who would buy a cheap car were it not for this marvelous motor

The Super Six is resistless Its performance will alter all your ideas of motoring And now, for the first time, a master feature is controlled for one car by a patent.

MOST LUXURIOUS CARS

The Super Six looks its supremacy The body lines are perfect The finish is superb In the upholstery we use a rare grade of grain leather Each compartment of the Phaeton has a rounded, finished dash.

In every detail we attain luxury's limit, regardless of the cost.

Yet our mammoth production brings the price to $1375 That for the finest motor ever built, in the finest car that's possible Go now and see this new car at your local Hudson showroom.

7 Passenger Phaeton $1375 at Detroit
Five Other Styles of Bodies Ask for Our Super Six Catalog

HUDSON MOTOR CAR CO., Detroit, Michigan

Packard

Motorize your Light Hauling—You can do it Safely and Profitably, now that PACKARD LIGHT SERVICE TRUCKS *are being Delivered to Customers*

THEY are built in two sizes, rated respectively at 1 to 1¼ tons and 1½ to 1¾ tons. The chassis price for the lighter unit is $2200; for the other, $2500, f. o b. Detroit. They answer fully the widespread demand for light service carriers of Packard quality, and properly supplement the heavy duty trucks now earning dividends in more than 200 lines of trade.

They offer an immediate solution of any hauling problem requiring a really well-built light service truck of simple design, with speed enough for a wide radius of action.

For heavier hauling there are other units in the Packard line Seven sizes altogether, ranging from 1—1¼ up to 6—6½ tons. *In sending for catalog, please specify weight and character of load.*

PACKARD MOTOR CAR COMPANY, *Detroit, Michigan*

Ask the man who owns one

SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV NUMBER 1 | NEW YORK, JANUARY 1, 1916 | 15 CENTS A COPY $3.00 A YEAR

Recently completed highway to the summit of Pike's Peak, 14,109 feet above sea level. The gradients average 6 per cent and never exceed 10 per cent

Looking back over the highway to Pike's Peak The road is 18 miles long The sharpest curves are from 25 to 50 feet wide

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs

Retrospect of the Year 1915

The World War

A CURSORY view of the military situation in Europe, as seen from the outside of the so-called "iron ring" which the Allies have attempted to maintain around the Central Powers, would seem to justify the assertion of the Imperial Chancellor von Hollweg, that Germany is everywhere victorious. She holds Belgium and one of the richest sections of France in the West, Poland is hers and, recently, with the aid of Bulgaria, she has overrun Serbia and opened up rail connection with Constantinople

The question of German success, however, is indissolubly bound up with the question of German aims, and, thanks to the explicit teachings of her military writers, we know exactly what the military aims of Germany were when the Kaiser let loose the dogs of war in the summer of 1914 A swift drive in overwhelming force upon Paris, the occupation of the French capital, an army of occupation in France a rapid transfer of the flower of the army to the Eastern frontier, and a furious campaign by overwhelming forces against Russia, for the purpose of breaking up capturing and dispersing the Russian hosts, preparatory to the occupation of Warsaw and Petrograd

The German plan, magnificent in conception, failed utterly when the allied forces under General Joffre turned furiously upon the invaders and threw them back at the battle of the Marne In the East the Austrian armies were overwhelmed by the Russian hosts The close of 1914 found the German army held fast in France, and the victorious Russians in possession of Galicia and making ready to pour down through the Carpathian passes into the plains of Hungary

In the early spring of 1915 Germany, taking over the supreme control of the Austrian troops broke through the Russian lines on the Donajec and commenced that great drive which must go down into history as one of the most stupendous military exploits of all time Brilliant as these operations have been there is a consensus of military opinion that they have been inconclusive The Russian army is to-day despite its reverses unbroken, its losses have been enormous but although it has bent it has never been broken The Central Powers have failed to disperse and disarm the armies of the Czar which under the spell of rest afforded by the rigor of the Russian winter are being reinforced and munitioned for the spring campaign

Judged, therefore, solely by the test of what Germany set out to do it must be confessed that she has failed The German lines in France are holding it is true but the Anglo-French drive in September gave every reason to believe that when another million of the British troops has been thrown into France and the requisite supplies of ammunition have been stored back of the allied position, it will be found possible to break through the German line on a front wide enough to cause a retirement of the whole front to new positions. Failing that, the war on the Western front must settle down to one of attrition, and judging by the acknowledged Prussian losses to date of 2,250,000 men and the monthly losses on all fronts estimated by the best military authorities at 300 000, the decisive issue must surely come before the close of 1917

The outstanding fact of the naval operations has been the remarkable success of the British defensive against the German submarine raid on merchant shipping The means adopted have been many and all appear to have been more or less successful The narrow channels have been netted, and great success has attended the towing of large nets between pairs of destroyers and trawlers. The swift destroyers have accounted for many and a vast fleet of fast motor boats, some of them private craft and others built specially for submarine chasing, acting in concert with the aeroplanes, has proved a veritable terror to the under-sea craft.

Since their disastrous running fight with the British battle cruisers, the Germans have remained in port, so far as the North Sea is concerned. The British battleship fleet at its station in the Forth of Firth, awaits the long-deferred coming out of the German fleet, while its scouts, destroyers and submarines scour the North Sea to give early tidings of the challenge, should it ever come

The various naval engagements have emphasized the supreme value of speed. Great Britain has completed the five 25-knot battleships of the Queen Elizabeth class. Since the war opened, by the way, she has added twelve dreadnoughts to her active fleet Also, she has just about completed five new battle-cruisers of the largest size and the unprecedented speed of 32 knots. Her destroyer fleet, moreover, has been increased by the addition of over 70 destroyers of 35 to 37 knots' speed. It begins to look as though nothing short of a miracle could break the strangle hold of the fleet upon the naval situation and in the opinion of the naval and military critics it is believed that this may prove to be the decisive factor in a war which seems destined to settle down into one of naval, military and economic endurance

National Defense

The close of 1915 found the United States Government involved in most serious diplomatic differences with Germany and Austria, due to the murder of American citizens upon the high seas As an offset to our case, the Central Powers believe that they have cause for a deep-seated grievance against us, on the ground that we have constituted our factories a veritable arsenal for the supply of ammunition to the Allies. It was the realization of the portentous possibilities of ultimate war contained in this international friction, coupled with the fatuous determination of the Administration to take no steps whatsoever in the direction of naval and military preparedness, that has led the people of the United States to inaugurate an agitation whose ultimate design is to force the hand of the Administration and Congress into taking proper measures for adequately strengthening our defenses on land and sea. How deficient these are is shown by a brief recapitulation Thus the Navy, which in 1904 stood second in strength is now third in material strength and fourth or fifth in the strength of its personnel As compared with the Navy of Germany we have 8 dreadnaughts in commission against her 22, we have not a single battle-cruiser to match against her division of 5 we have 3 old and slow scouts to match against her fleet of a dozen or more 28-knot scouts, and, finally, we have a miscellaneous lot of small, non seagoing submarines as compared with Germany's large fleet of big, able, sea going submarines, which, in common with their officers and crew, have been keyed up to a high pitch of efficiency during many months of deep-sea service under war conditions

As showing the farcical weakness of our mobile land forces, it is sufficient to say that we have in the continental United States to-day only 30,000 effective mobile troops of the Regular Army We have possibly, 60,000 effective militia, but, in the event of a surprise invasion it would take 30 days to concentrate these 90,000 regulars and militia against the enemy The Administration, taking note of the temper of the country, as expressed in the Navy League the National Security League, the American Legion, and other non political and purely patriotic movements for defense, has submitted programmes for the enlargement of our forces. The five-year building programme of the Secretary of the Navy, while correct in principle, is too remote in its results to meet the crisis We should build up to the full capacity of our Government and private yards until the neglect of the past has been made good The plan of the Secretary of War for the increase of the Army has the serious defect that reliance is placed upon a so-called "continental army" of 400 000 men, which, it is our firm conviction, would never materialize The proper remedy is to be found in an increase of the Regular Army from its authorized strength of 110,000 to at least 200,000 men, and the building up of a regular reserve until we have, with the colors and in reserve, a total of 500,000 trained regulars With this force assured to take the first shock of invasion, we should prepare, back of it, a trained volunteer reserve of 500,000 to 800,000 men.

Engineering

It was inevitable that the great war would interfere with those great engineering activities of a civil and mechanical character which are designed primarily for the uses of peace. Not that the war has rendered the engineering world idle, on the contrary, it has been called an engineers' war—which, indeed, it is, for there is scarcely a single branch of the engineering arts which is not represented in the activities of the war.

As a result of our freedom from war, the engineering works in this country have gone forward without interruption. Our steam railroads have been extended and notable progress has been made in the application of hydro-electric power to the hauling of main line traffic. The New Haven electrification has been extended to New Haven and put in full operation, both for freight and passenger service. This alternating current installation therefore extends for over seventy-five miles. The New York Central, using the direct current system is operating to Croton, a distance of thirty five miles. A recent notable electrification is that on the stretch of the four-track Pennsylvania Railroad between Philadelphia and Paoli, and that on the Norfolk & Western Railroad between Bluefield, W .Va., and the coal mines. The abundance of hydraulic power in the Rocky Mountains has made possible the extensive electrification of the Mountain Divisions, such as that of the Butte, Anaconda and Pacific Railway and the Chicago, Milwaukee & St. Paul Railway

In no country of the world is there such activity in the construction of dams and reservoirs of great size as in the United States. One by one, the great reclamation projects of the West and Middle West are being completed. The Bassano Dam in Southern Alberta, Canada, exceeded only by the Assouan Dam in Egypt, was opened early in the year. It provides water for 440,000 acres. Also there has been put in service the Arrowrock Dam near Boise, Idaho. This is an arch dam, 1,100 feet long on the top and 348.5 feet in total height —the loftiest structure of its kind in existence. The massive Olive Bridge Dam forming the Ashokan Reservoir for the supply of New York city with 500 million gallons daily, has been completed. The dam is 220 feet in height, 4,650 feet in length, and has a capacity of 132 billion gallons. The 92-mile aqueduct from the dam to New York city is practically completed, as also are the deep tunnel beneath Manhattan and Brooklyn and the pipe line across the Narrows to Staten Island The Panama Canal, after being for a great many months in successful operation, was completely closed during the autumn of 1915, by two enormous slides on the east and west sides of the Culebra cut, which extended along the bank for 2,000 feet. The break reached back over 1,000 feet on each side of the canal, and, altogether, between 7,000,000 and 10,000,000 cubic yards of earth were set in motion. The problem is one of simple digging until the ground on either side reaches its natural angle of repose A notable event in the history of bridge design and construction was the completion late in the year of the 1,000-foot span, arch bridge, over the East River at Hell Gate, New York This is not only the longest arch bridge, but it is the heaviest steel bridge per linear foot of its length, in the world. The structure weighs twenty six tons per foot of length, and it has a capacity of four of the heaviest freight trains on four tracks.

The war has had no effect of checking the progress of the greatest work of tunnelling in the world, as represented by the new subway construction in New York city This vast work, which has been pushed along with great activity during the past year embraces 325 miles of subway and elevated single track making, with the existing subway, 621 miles which ultimately will be at the service of the city The new work includes 150 miles of tunnel under construction, and in this will be included, when the whole work is opened up, eight new single-track tunnels under the East River and a new four track tunnel under the Harlem River The total cost of the new work will be about equal to that of the Panama Canal (exclusive of the cost of the slides), or, say, about $365,000,000.

Electricity

Were it not for two remarkable achievements, transcontinental telephony and transatlantic radio telephony the year 1915 would be barren of any truly startling contributions toward the progress of electricity It appears that but little has been done in the way of important research and experimental work by the scientists at large, and this is readily accounted for in view of the fact that the greater number of them have been called to the aid of their country either as soldiers or in an advisory capacity

Radio communication has scored heavily in the development of the radio telephone. Totally unexpected even by those who closely follow the subject, was the announcement of successful wireless telephony between Arlington and San Francisco, Darien (Panama), Honolulu and Paris. The greatest distance achieved by the wireless telephone is recorded as 4,900 miles, while the record for radio telegraphy was between Nauen (near Berlin) and Honolulu, a distance of about 9,060 miles In the United States there has been evinced an effort to standardize the wireless equipment of steamers by the leading companies. The radio amateurs have joined in goodly numbers the organizations formed with an

[illegible] of being of service to the Government in time of war or emergency.

Second in importance to the radio telephone success has been the transcontinental telephone line permitting of conversation to be held between the East and the West, a distance of 3,400 miles by wire in the instance of New York and San Francisco.

The war has been instrumental in developing many new applications for electricity, prime among which have been those making use of the microphone for the detection and actual locating of invisible airships and submerged submarines. In the hospitals behind the firing lines powerful magnets have been used for removing shell splinters from the flesh of the wounded, and special lamps have been used for hastening the healing of wounds. Electrified fences have been used by the fighting nations to some extent.

The electrification of railroads has progressed to a considerable degree, not only have there been new converts to this form of motive power, but railroads that were already using electricity have increased their electrified zone. Of great moment has been the electrification of the Chicago, Milwaukee & St. Paul Railroad, in that it represents the first direct current installation of such a high potential, 3,000 volts.

Among the most conspicuous new devices introduced have been the thermophone, a telephone of diminutive size employing the thermal rather than the magnetic properties of electricity, the audion lamp as a producer of music, and the phonopticon which enables the blind to read printed matter making use of the variable resistance of selenium under the action of light. New types of lamps and improvements over the old ones have appeared, the object being more light with less current consumption and the accurate testing of colors.

The Automobile

Alike in its magnitude and in the quality of its output, the automobile industry during 1915 has made a notable advance. Despite the enormous growth of the previous year, not only has there been as yet no sign of the peak of the demand being reached, but the industry is expanding at a rate which so far as we know is unapproached by any of the other leading industries of the country. Very impressive is the fact that some of the largest establishments have new construction in the way of buildings and plants in hand which will double and, in some cases, triple the present output. This vast enlargement is being made for several sound economic reasons, one of the most important of which is the fact that increased production means lower cost and the ability to offer the public a thoroughly reliable car at a greatly reduced price. Not only is the price of the car being reduced as the result of increased production, but, in laying out the great extensions of their existing plants, the manufacturers are introducing the latest automatic machinery and are adopting those principles of orderly sequence in the construction of the various parts and their assembling in the finished machine, which have so largely contributed to the low cost of certain well known cheap cars.

The most interesting mechanical development of the year has been the growth in popularity of the multi-cylinder car, as represented by the twin four and the twin six, the former mounting an eight cylinder and the latter a twelve-cylinder engine. The advantages of the multi-cylinder car are so fully dwelt upon elsewhere in this issue, that they need no elaboration here, it is sufficient to mention the constant and even torque, the absence of vibration, the great flexibility of control and the rapidity of the acceleration. Excellent as was the performance of the six-cylinder car, it was realized that for touring in rough, hilly country there was yet something to be desired, and the demand has been met most satisfactorily by the multiplication of cylinders. With the reduction in the size of the cylinders there has come a reduction in the weight of moving parts and a much higher speed of revolution. This has rendered possible a great increase in the horse-power with a relatively slight increase in the weight of the engine. The writer recently witnessed the block test of a twelve-cylinder engine rated at 38-40, which at 3,000 revolutions developed 110 brake horse-power. There has been a greatly extended use of the self starter, particularly of the electric type; and the prevailing practice is to install a generator for starting and lighting. An interesting development of the year has been the putting in service of a new gas-electric drive which has given excellent results in actual service. This car was described in our issue of Nov 27, 1915. The engine and electric transmission constitute practically a small generating station, consisting of a six-cylinder gasoline engine, a generator and a motor. The gas engine drives the field of a generator which supplies current to the motor. The current passes through a controller similar in its action to the ordinary trolley car controller. The advantages of the system are that it acts as its own self-starter; it eliminates the change-speed lever; it gives the widest possible range in speed control, and the interposition of the electric transmission between the engine and the rear wheels, provides a cushioning effect which assists in giving the car its smooth running qualities.

One of the notable developments of the year has been the marked reduction in price of some of the high priced cars, a tendency to eliminate many of the cheap and over light cars and substitute therefor a more substantial and somewhat more costly car. It begins to look as though the standard car of the future when the present process of evolution has been completed, will be driven by a small bore engine running at an exceedingly high speed of revolution, that it will be of a weight midway between the present heavy and expensive car and the cheap runabout, and that its cost will be about twelve hundred dollars.

Aeronautics

In reviewing the progress of aeronautics for the year that has just drawn to a close the one fact that stands out from all the rest is the predominating influence of the war. Achievements in general have been more of the nature of substantial engineering advancement than of sensational flights and records such as have characterized former years.

Gigantic aeroplanes have been developed by the fighting nations in an endeavor to secure the command of the air. Biplanes and triplanes of over 100-foot spread are either built or are building while machines of more modest dimensions equipped with two or three power plants, have made their appearance on the field of battle. Such aircraft are equipped with one or more rapid firing guns of 1½ to 3 inch calibre as well as several machine guns. In some of the larger machines the crew numbers six or more while the amount of fuel, provisions bombs and ammunition carried exceeds the expectations of the most far sighted aeronautical constructor of antebellum days.

The demand for bigger machines has naturally reacted on engine construction with the result that more powerful aeronautical power plants have been built of late. As in the instance of the motor car the twelve cylinder aeronautical engine is hailed as the final word in heavier than air craft propulsion. Motors of this type are being made in sizes ranging from 100 to 250 horse-power. The rotary engine which dominated the field previous to the past year is being largely replaced by the stationary cylinder types due to the fact that the latter have been found more simple easier to repair and of greater reliability especially in their improved forms. There has been evinced a sustained effort on the part of the engine builders to follow automobile practice in the design of airship power plants.

The equipment of military aeroplanes has been greatly improved and numerous refinements made in the smaller details of construction. Some of the fighting aeroplanes particularly the German machines, have proved luxurious in the matter of equipment.

The high rate of depreciation of military aeroplanes has given aeroplane manufacturing a tremendous impetus. Crude methods and equipment of former days have been replaced by labor saving machines and efficient systems, made possible by quantity production. Particularly in America has this change been most conspicuous, one plant at least being now placed on a basis comparable to that of the smaller automobile shops.

The military efficiency of aeroplanes has been greatly raised during 1915. Aerial raids of unprecedented magnitude have been successfully undertaken. Considerable damage has resulted from some of the raids. On the other hand dirigibles have failed to prove of military value although participating in numerous forays.

The transparent aeroplane has it is reported made its appearance on the French front but official confirmation is lacking. However it is known for a certainty that both the French and Germans have been hard at work developing transparent plane surfaces with more or less success.

The development of anti aircraft artillery has reached a point where it is decidedly uncomfortable for an aviator to fly at an altitude lower than 10,000 feet. Previous to 1915 the average range of aerial artillery was below 5 000 or 6 000 feet.

Most remarkable of all is the fact that no international records appear to have been broken, while on the other hand several new American records have been made. Among these are DURATION.—Aviator alone, Lt. Byron Q Jones, U S A. January 15 8 hours, 53 minutes, aviator and two passengers Lt Byron Q Jones, U S A., March 12, 7 hours, 5 minutes. ALTITUDE.—Aviator and one passenger, Lt J E Carberry, U S A., January 5, 11 690 feet, aviator and two passengers, R. V Morris, August 10, 8 024 feet, aviator and three passengers, August 10 8,105 feet. DISTANCE FOR HYDRO-AEROPLANES.—Aviator and one passenger, Lawrence B. Sperry, January 20, 60 miles. DURATION FOR HYDRO-AEROPLANES.—Aviator and one passenger, Lawrence B Sperry, January 20, 1 hour, 25 minutes. ALTITUDE FOR HYDRO-AEROPLANES.—Aviator alone, Lt P N L Bellinger, U S N, April 23, 10,000 feet, aviator and one passenger, Lt. H. Ter Poorten August 31, 8,830 feet.

Science

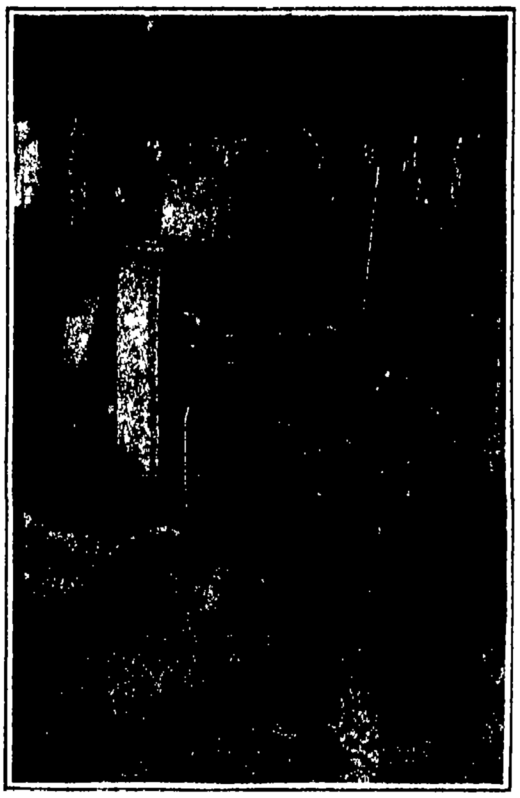
It can hardly be expected that the past year should show a very good record of achievements in the world of pure science since the upheaval in Europe has drawn many scientific men from their work and has placed the few that remain in an atmosphere far from favorable to the pursuit of science for peaceful ends. Added to this is the depletion of the ranks of typesetters which we are told has caused delay in the publication of some of the work that has been done. The war has not of course had a similar effect in this country and we have one very remarkable record to our credit the successful communication by wireless from Washington to Honolulu and Paris. Much attention has here been directed towards the building up of some of the chemical industries which are so highly developed in Germany and for the products of which we have hitherto been largely dependent upon Europe. There is a good deal of work being done in this direction the results of which have not yet clearly emerged to the surface.

If the war has repressed scientific work in Europe along the usual lines it has brought some developments arising directly from war conditions. Necessity is the mother of invention. We hear of special efforts in Germany to meet the situation that is imposed upon it by the Allies navy. The production of fodder from yeast is one of the signs of this activity which we have recorded in our columns.

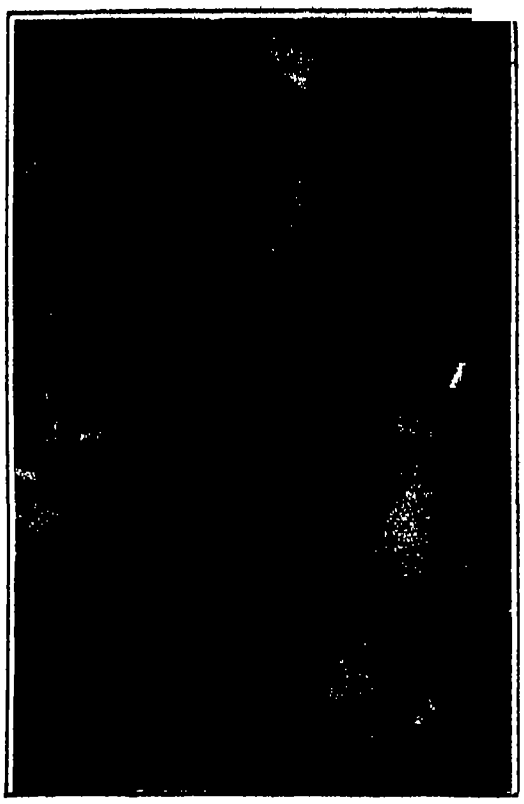
Surgery has found in the field of war the most abundant scope for development and there can be no doubt that much valuable knowledge has thus been gained. The psychology of the soldier in the field has been found to present phenomena of remarkable interest. Science will be able still to reap some few crumbs of benefit at a time when we are appalled by the losses and destruction wrought by so large a portion of our race.

Astronomy

Astronomy probably suffered less by reason of the war than any other branch of science because this country has always paid particular attention to astronomical research and has provided more elaborate equipment for such study than have the European nations. Despite the war some work has been done at observatories in the very midst of the fighting regions. The European clearing station for astronomical news was formerly the Zentralstelle für astronomische Telegramme at Kiel. When war broke out this service had to be discontinued but it has since been resumed at the University Observatory of Copenhagen under the direction of Prof. Elis Strömgen. About a week before the war broke out the block of glass for the 72 inch Canadian reflector started from Antwerp so that work on this telescope has not been delayed and is now nearing completion. This will be next to the largest telescope in existence the largest being the 100-inch reflector for the Mount Wilson Observatory. Work on the installation of the latter has been delayed to some extent by the naval activity at the ship building plant where large steel members of the observatory are being made. However the work should be completed very soon. It is believed that this big telescope will enable us to photograph a hundred million new stars. The year 1915 has not been marked by any special celestial phenomena. There were only two eclipses, both being annular eclipses of the sun. The first occurring on February 13th and 14th was seen in the Indian and Pacific Oceans and the northwest portions of Australia. The path of the second annular which occurred on August 10th was confined to the Pacific Ocean and was visible as a partial eclipse in Hawaii. Five comets were discovered during the year. The last comet of the year was discovered by Taylor at the Cape of Good Hope at the beginning of December. Of the three new comets two were discovered by John E Mellish of Cottage Grove Wisconsin on February 10th and September 13th respectively. Tempel's periodic comet was rediscovered by Delavan at the La Plata Observatory Argentine on May 16th, and Winnecke's comet was rediscovered by Thiele at Hamburg on April 4th. A matter of considerable popular interest in this connection is the inauguration of a systematic study of meteors in order to investigate their supposed relation to the lost comets. In this research the coöperation of amateur observers has been called for and has met with a ready response. The search for another member of the solar system beyond Neptune is going on and Dr H H Kritzenger believes that there is a good chance of finding a transneptunian planet in Sagittarius or Capricornus this winter. Systematic studies of the sun are being carried on at the Mount Wilson Observatory. Discoveries have been made at that observatory which promise to determine a star's distance by measurement of its brightness and the relative intensities of certain lines in its spectrum.



The machine that does the finish grinding of balls



A tumbling barrel in which the balls are polished

Automatic ball grading and sorting machine

Balls and Ball Bearings

How Devices for Reducing Friction Are Made

FRICTION—the great handicap which all moving bodies have to overcome—has been reduced to a minimum in the rotating parts of an automobile, which amounts to a practical if not a theoretical, zero The actual amount of motor power absorbed by the freely revolving ball bearings, used in modern motor cars is so small as to be unnoticeable by any but the most sensitive detecting instruments It is not too much to say that the highly developed ball bearing has made the low priced efficient automobile possible—it is most certainly true that without the automobile as an incentive to further elimination of friction the ball bearing would not have reached its present pre-eminence

Without going deeply into the history of the ball bearing industry it may be stated here shortly that the bicycle was probably the first cause of the ' frictionless bearing When the puny power of the human leg was utilized in pushing forward a wheeled vehicle, anything that increased this power by reducing the ever present friction was sure to be hailed with joy by the great public And when the bicycle industry branched out into the power bicycle and the full fledged automobile the lessons of rotary friction in place of sliding friction were utilized to the best advantage

When a shaft rotates in a plain bearing it slides within this bearing on much the same principle as a sleigh slides over the snow Rolling friction, as exemplified in the carriage wheel is far less than sliding friction of the same relative load and the adoption of the ball bearing really was nothing more or less than the introduction of the rolling type of friction into the wheelhubs—just as the rolling friction of the outside rim of the wheel had impressed the first trading nations with its superiority over the sliding runners of old time sledges

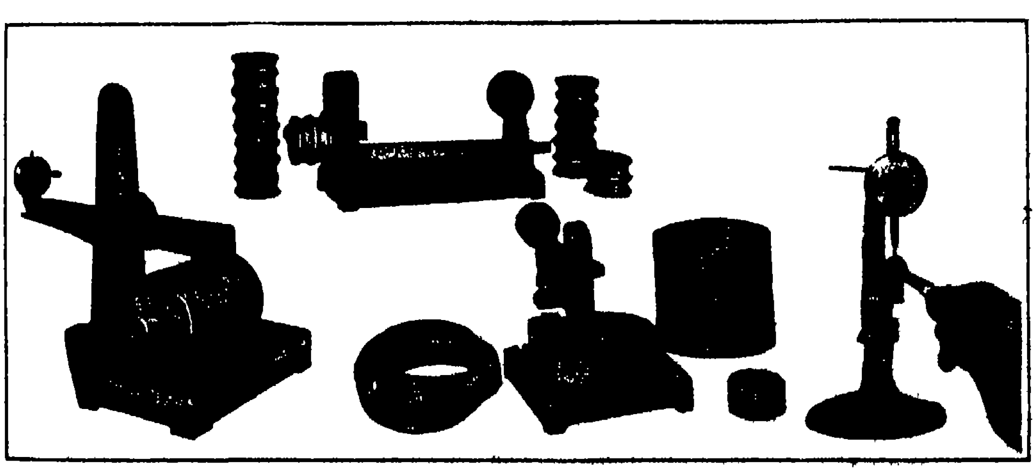
The modern ball bearing is not a haphazard invention, nor has it reached its present state of almost uncanny accuracy without serious difficulties Units of measure, formerly employed only in the construction of highly sensitive optical instruments are an ordinary shop-term in the modern ball bearing factory Fractions as small as one-twenty thousandth of an inch drop from the lips of shop foremen as if there were any human eye capable of appreciating such a measure! The lay mind has no conception at all of what one ten thousandth of an inch represents, and yet this measure is the limit of inaccuracy permitted in a ball bearing while several manufacturers of steel balls cut even this minute fraction in half and demand accurate work to within one twenty thousandth of an inch Let the reader take a finely graduated steel rule on which the inch is divided into 64 parts let him try and imagine one of the small spaces subdivided into 300 sections—and he will have obtained a fraction still slightly larger than the accuracy limit in a steel ball plant!

Final inspection on a glass tray for surface blemishes, soft spots and fire cracks The girl holds a piece of white cardboard in her left hand to reflect light onto the balls

How such incredible accuracy is obtained under the general working conditions of a large machine shop, is one of the marvels of the ball bearing industry

Among the industries of this country which were hard hit by the suddenness of the European war, none perhaps received such a shock as the ball bearing industry, and none, to its credit be it recorded rose so quickly and successfully to the demands placed on it At the time of the outbreak of the war one half of America's consumption of ball bearings was supplied by Europe, either as finished balls and bearings or as the raw steel of special composition, which is required for their manufacture

The Raw Material—By far the largest part of all balls in ball bearings are made of chrome steel, compounded and melted according to a formula invented by a German engineering chemist Germany and Sweden in particular made a specialty of producing this kind of steel and reached such a state of perfection that other nations, instead of trying out and testing their own steel alloys, came to regard these two pioneers as the only available sources of supply During the years 1910-14 the demand for ball bearings in this country grew so enormously as to surpass the capacities of the European plants, and a rival industry in this country arose which at present bids fair to command the markets of the entire world Huge plants have been built, still larger ones are proposed, while Europe is unable to attend to its business of steel ball manufacture for bearings—being too busy making iron balls for shrapnel Sweden alone is in a position to ship balls and bearings to the United States, but its whole output is but the proverbial drop in the bucket, when intended to supply the American automobile industry



A group of delicate devices used for gaging ball races, in which the indicating dials show variations of a ten-thousandth of an inch. At the right is a Brinell machine for testing hardness

The present output of balls and bearings in this country is not known pre-

precisely A fairly accurate estimate places it at 60,000 tons of chrome steel, in the raw form, and not less than 18,000,000 complete bearings in the course of a year. One of the largest manufacturers of ball bearings turns out 20,000 bearings a day, while the foremost manufacturer of steel balls can produce for this purpose 5,000,000 balls a day The number of balls in each bearing varies from 12 to 38—the first being an ordinary "single row" bearing of the small type, the latter a double-row bearing of the largest size The number of steel balls mentioned includes those used in bicycles, automobiles, baby carriages, sewing machines, talking machines and other articles bought and used in quantity The number of bearings given includes only those in the automobile and motorcycle industries.

Shaping the Balls—Although the construction of the entire bearing is based on the greatest possible accuracy, it is in the manufacture of the revolving steel balls that the chief care must be taken. A slight unevenness in the "race ring" or the "raceway"—as the sections of the bearing itself are called—does not have the disastrous results which follow the introduction of an uneven, or slightly larger ball into the race The ball because of its inaccuracy has to carry momentarily the whole load, or is subjected to sudden stresses far beyond its capacity It cracks—and the whole bearing is ruined unless the damaged ball is speedily removed from it

The best bearings, however, are so accurately proportioned that each ball carries the same maximum load

The chrome steel, from which the balls are to be cut, arrives at the factory in the shape of a thick steel "wire"—somewhat larger than necessary for the cutting of the balls It is re-drawn to size, and fed into a machine which cuts off small cylindrical pieces These pieces immediately drop into a second machine where they are gripped between two dies and squeezed into globular form This squeeze leaves the future balls with a ragged "fin" where the two dies have met, and a rough grinding process removes this metal edge, before the balls are sent to the heat treating furnaces

These furnaces gas fired and electrically controlled, are a wonderful sight More than a hundred are grouped in the factory of one of the largest makers and every one is directly connected with a switchboard fitted with a potentiometer pyrometer This instrument registers the smallest change of temperature in the furnaces, three deg Fahr being considered the limit of variation permissible The furnaces have an average temperature of 1 700 1 750 deg the exact treatment for each shipment of steel being prescribed by metallurgists after a complete analysis of the composition of the steel and laboratory tests of its properties If the temperature in these furnaces varies more than three deg from that required a green or red electric light (too cold or too hot) flashes the signal to the furnace inspectors whose sole duty consists in watching for these signals

After leaving the hardening furnaces the balls are placed into hoppers, from which they are fed to vertical grinding discs covered with abrasive material When the machine is revolved, the balls roll in a V groove being fed into the center of the discs and travel to the outside over the abrasive, whence they return to the center automatically This grinding process is extremely slow as the balls are so hard that the time required is from three to five hours, depending on the amount of reduction in size necessary Every now and then an attendant takes one of the balls from the outside of the discs and checks it on a gauge When it has reached the required size the hopper is taken out and the contents dropped into tubs, mounted on shafts inclined 45 deg to the horizontal A quantity of small bits of leather is mixed with the balls. As the tubs are revolved the balls roll rapidly over and over against each other, and against the leather until the fine abrasive dust from the grinding has been removed, and the product has taken that highly polished exterior which one unconsciously associates with the commercial bearing balls.

The balls are now ready for mounting in bearings, but there is a considerable variation in their sizes, a variation reaching as much as one five-hundredth of an inch As the limit of inaccuracy between two balls in a single bearing is one ten-thousandth of an inch, there is still an assorting process to be gone through before the balls are ready.

Assorting the Balls—Next to the manufacture of the balls, the assorting process is of the greatest interest to the average visitor Two long, V-shaped, sharp-edged pieces of the hardest steel are mounted *almost* parallel—the width between the extreme ends differing by only a minute fraction of an inch The balls issue one by one from a hopper, and roll along the edges of the steel knives until they find a spot which permits them to drop through Twelve boxes are placed below the assorting knives, and they are so arranged as to receive only such balls as differ from all the others dropping into the same box, by less than one ten thousandth of an inch At the extreme ends of the knives are boxes for the "misfits"—that is to say for balls that are either much too large or much too small. The percentage of these wasted balls is very small

Each box of balls is then turned over for final inspection to girls especially trained in this work They are placed about fifty at a time, in wooden trays having plate glass bottoms on which the balls are rapidly rolled in various directions The slightest irregularity in the roll indicates a defect in shape that is instantly detected by the trained inspectors who also are wonder fully expert in detecting other defects Quite a number in each box fail to pass the sharp eye of the girl charged with the final testing

In some plants wonderful automatic devices are employed for this purpose, as machines never tire, and are not affected by the human element

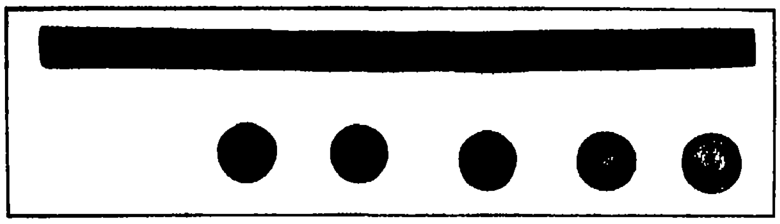
Assembling the Bearing—Each box of finished balls is then turned over to the assemblers who are only permitted to use balls of one box for one single bearing Under no circumstances must a man take "just the one" ball necessary to complete a bearing from any other box than the one he has been working with For there may be a difference of one five-thousandth of an inch between the contents of two boxes, or even more and that would spell disaster to the bearing

At the assembling tables the balls are met by the bearings coming from another part of the plant The bearing in the first rough stages undergoes the same process of cutting off rough grinding and heat treatment that the balls pass through Large rings and races—as the outer bearings are called are cut directly from chrome steel tubes of the required diameter and then ground and polished Small races are cut from solid bars and each race is subsequently bored out.

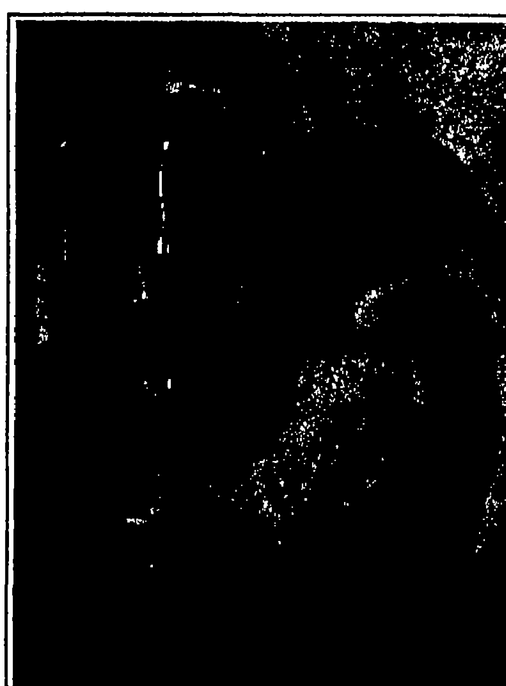
The method of assembling differs in the various types of bearings Where the old style cup and cone for bicycles is used it is very simple and requires no explanation Where solid races are used without even the famous small curved notch in the outer and inner races through which the last few balls in each race are sprung while exactly opposite each other the insertion of the last two or three balls is highly interesting Specially designed patented machinery springs the last few balls into these races in such a way as to avoid deforming them

Where soft steel outer shells are used the assembling sequence is as follows First the outer race ring then the center member the cages and all the balls (one by one) and finally the second outer ring which is squeezed on The bearing is then mounted in a lathe and the soft steel shell is spun over the open end The bearing is completed but so tight that it cannot be turned It is now gripped in a chuck and pressure applied to the outside with a burnisher The soft steel gives way under the pressure and flows until the outer shell becomes slightly lengthened and the cups are loosened A few moments of such spinning makes the bearing run freely in its shell The outside deformation and discoloration in the burnishing process is removed by grinding and polishing on the outside while all foreign grit and lint is removed by forcing oil under pressure through the finished bearing It is then packed in grease-proof paper and ready for shipment

If the average motorist took one thousandth as much care in the use of his bearings as the manufacturer takes in making them there would never be any complaint But bearings are subjected to stresses for which they never were intended and to abuse by being run without lubrication or with broken steel balls Properly treated the American ball bearing is at least equal to if not better than the foreign made bearing Without it the automobile industry would be in a sorry predicament



The raw material, and balls in their five stages of manufacture



Testing ball bearings with a Brinell machine

Leitz photo-microscopic apparatus, used for examining micro-structures as well as the finish of races

In What Position Does a Pointed Infantry Bullet, Shot Vertically Along a Straight Trajectory, Return to Earth?

When this question was raised seven years ago in the periodical *Schuss und Waffe*, there was no unanimous opinion even among hunters and gun experts In order to solve the problem a special shooting stand was erected upon the experimental station of the *Deutsche Jagerzeitung* in Neudam (Mark) the strong roof of which afforded ample protection against falling bullets Close to this gallery an infantry rifle was clamped in such a position as to send the bullet upwardly in an absolutely vertical direction The experiments were carried on in the proximity of a lake the surface of which was frozen The ice was covered with strong planks Shots were fired in almost absolutely calm weather and the bullets searched for in the planks upon the ice

It was shown that an infantry rifle bullet shot upward in a vertical direction passes downward again in the same position in which it passed upward i e it came back again to the earth with its bottom first Why was it not upset at its culmination point? The bullet was subjected to two forces the propelling force and the twist The propelling force ceases to act at the culmination point the bullet stands still for a moment, then begins its fall But the twist has as yet not stopped and therefore it starts its fall with twist and that in the same direction of rotation it had when fired

As the bullet, rotating upon its base plate, offers a greater surface to the air, its fall must be very slow The damage done to the planks when it strikes the ground is always slight. Even on impact the twist had not stopped, for the warping of the wood fibers in the direction of rotation of the bullet could be seen

The Automobile of 1916

Prominent Innovations That Distinguish the New Models from Their Predecessors

By Victor W Pagé, M. S. A. E.

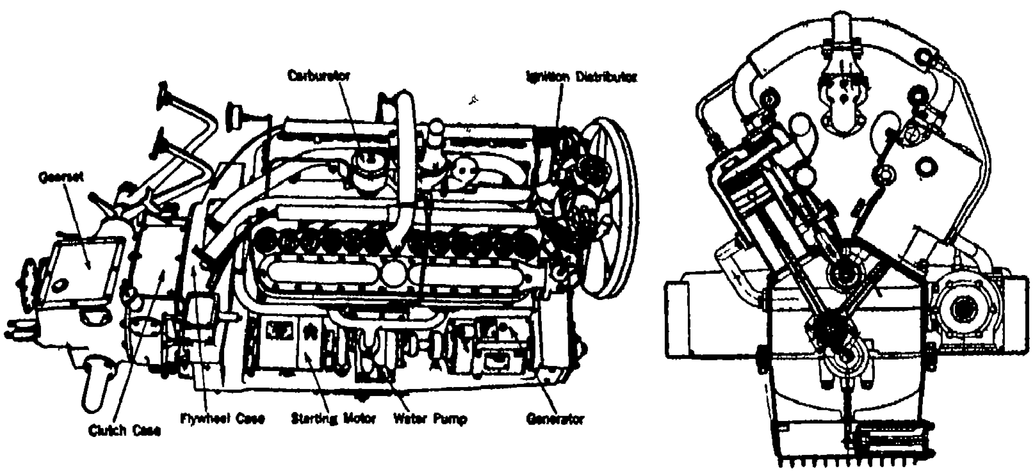
WHEN the many excellent cars produced during the season just passed were first announced the motorist and those in the automobile industry believed that the development of the modern motor car was reaching a point where improvements would be only a matter of minor detail and that no radical developments would be announced for the car of 1916 It was believed that the eight cylinder motor marked the practical limit of the multiplication of cylinders and that no further simplifying of the mechanism was possible or practical It was conceded by many well versed in automobile construction that the practical limit in weight reduction had been reached It was thought that further price reduction could not be made without a marked sacrifice in quality

Contrary to the general belief the development of the automobile did not reach the final point because there are just as marked mechanical improvements in the designs offered for the 1916 season as have been previously made in any year since the automobile attained its present general form

Popularization of the Eight- and Twelve-Cylinder Cars

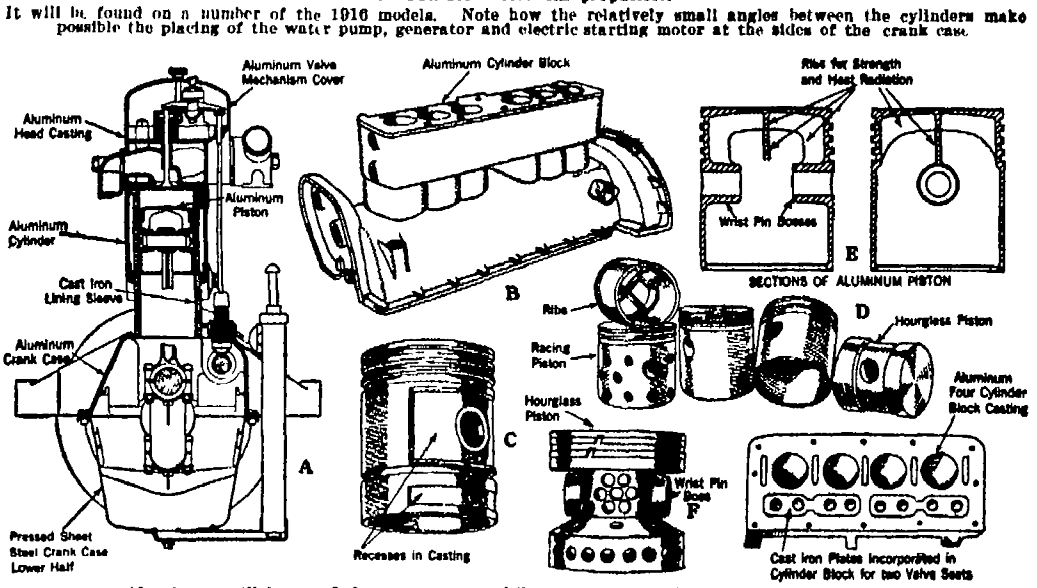
As a logical result of the eight cylinder movement, the twin six or twelve cylinder engine stands out as one of the most marked developments of the new season The adoption of eight cylinder motors by a large number of manufacturers for the coming season is also a surprise not because the practicability of the V engine having that number of cylinders was questioned but because the six cylinder engine had been developed to a point where it was thought sufficient for all practical needs It not only provides smooth running and even application of power with a ready acceleration, but it also provides a power plant that is practically vibrationless and that can be throttled down so a very low car speed may be obtained without shifting gears

When first introduced it was thought that the eight cylinder engine would be suited only for the larger cars and that the added complication would make this type unsuitable for use in the moderate priced cars purchased by people of modest means who act as their own chauffeurs Even this belief was destined to be changed by the introduction of not only small eight cylinder motors, but also small twelve cylinder power plants intended for cars selling around $1 000



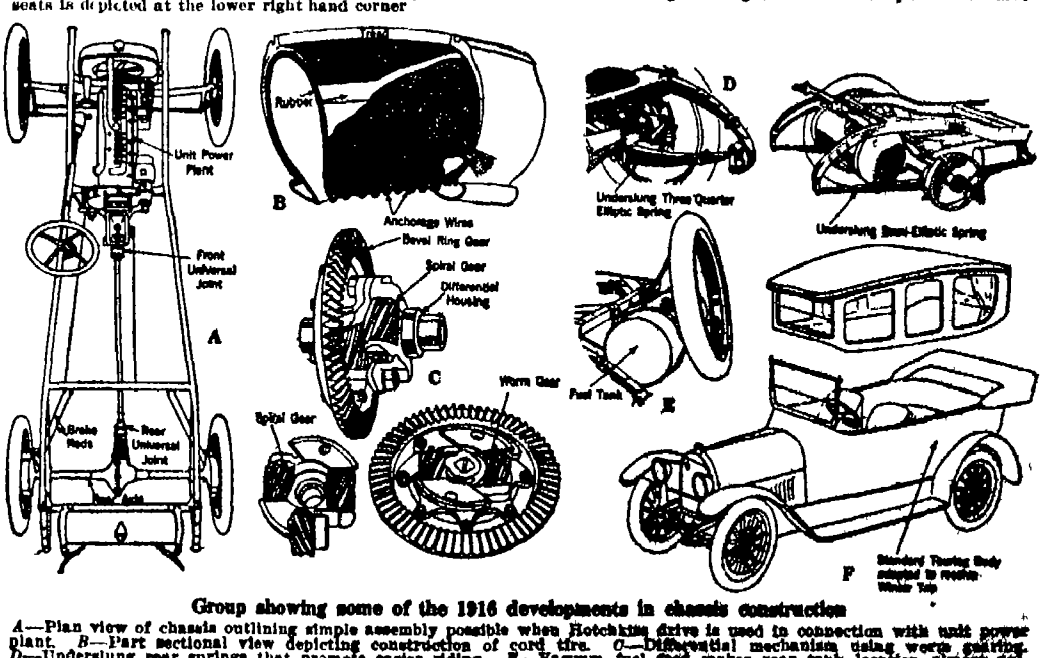
The twin six automobile power plant is the latest development in internal combustion engines intended for motor car propulsion

It will be found on a number of the 1916 models. Note how the relatively small angles between the cylinders make possible the placing of the water pump, generator and electric starting motor at the sides of the crank case



Aluminum will be used for more automobile engine parts during the coming season

The sectional view of the overhead valve motor at *A* shows the use of aluminum cylinder block and cylinder head casting A six cylinder aluminum block casting is shown at *B* while various interesting forms of aluminum pistons are shown at *C* *D* *E* and *F* Top view of a four cylinder aluminum block casting showing the use of iron plates for valve seats is depicted at the lower right hand corner



Group showing some of the 1916 developments in chassis construction

A—Plan view of chassis outlining simple assembly possible when Hotchkiss drive is used in connection with unit power plant. *B*—Part sectional view depicting construction of cord tire. *C*—Differential mechanism using worm gearing. *D*—Underslung rear springs that promote easier riding. *E*—Vacuum fuel feed makes rear tank location almost universal. *F*—Removable limousine top that will convert standard touring car to one better adapted for winter use.

It does not seem to the writer that there is a sufficiently marked advantage in the use of eight and twelve cylinder motors to warrant the added complication in cars intended for the masses. Repair costs cannot fail to increase in almost a direct ratio to the number of cylinders employed as relates to power plant maintenance Expert repairmen have submitted figures showing this to be true So the problem resolves itself into the balancing of the advantages and increased maintenance cost of the eight and twelve cylinder cars against the simpler four and six cylinder types, and arriving at a decision in this controversial question.

Improvements in Engine Design

It is not only in multiplying the number of cylinders or arranging them in V form to obtain compactness that the automobile power plant of 1916 has been improved. The speeds of crankshaft rotation are higher than ever before, and many touring car motors run at higher speeds than the racing car power plants of a few years ago More power is therefore obtained for a given piston displacement than formerly; this being made possible by an increase in valve sizes, changes in compression ratios and the adoption of automatic pressure feed lubricating systems that insure the thorough lubrication of every internal motor part. The great increase in crankshaft speed has been made possible by better balancing and the lightening of reciprocating parts. Aluminum pistons have replaced cast iron members in many motors, as these weigh about one-third as much as the cast iron forms of the same size, while the reduction in the inertia forces has made it possible to increase the engine speed without correspondingly stressing the connecting rods, crankshaft and engine bearings.

Aluminum has not only been used for pistons, but a number of motors will be built for the coming season that will use aluminum cylinder block castings as well. Of course, the aluminum alloy is too soft to be used as a bearing for the piston and it will not withstand the hammering action of the valve. This makes the use of cast iron imperative in all motors. When used in connection with an aluminum cylinder block the cast iron pieces are placed in the mould so that they act as cylinder liners and valve seats, and the molten metal is poured around them when the cylinder is cast. It is said that this construction results in an intimate bond between the cast iron and the surrounding aluminum metal Aluminum has for a number of years been used in many motor car parts. Alloys have been developed that have greater strength than cast iron and that are not so brittle Its use for manifolds, clutch cones and engine crank and gear cases has been general for a number of years.

At first thought it would seem as though aluminum would be entirely unsuited for use in those portions of internal combustion engines exposed to the heat of the explosion, on account of the low melting point of that metal and its disadvantageous quality of suddenly "wilting" when a critical point in the temperature is reached. Those who hesitated to use aluminum on account of this defect lost sight of the great heat conductivity of that metal, which is considerably more than that of cast iron. It was found in early experiments with aluminum pistons that this quality of quick radiation meant that aluminum pistons remained considerably cooler than cast iron ones in service, which was attested to by the reduced formation of carbon deposits thereon. The use of aluminum makes possible a marked reduction in power plant weight. A small four cylinder engine which was not particularly heavy even with cast iron cylinders, was found to weigh 100 pounds less when the cylinder block, pistons, and upper half of the crank case had been made

of aluminum instead of cast iron. Aluminum motors are no longer an experiment, as a considerable number of these have been in use on cars during the past year without the owners of the cars being apprised of the fact. Absolutely no complaint was made in any case of the aluminum motor and it was demonstrated, in addition to the saving in weight, that the motors cost no more to assemble and cooled much more efficiently than the cast iron form. One of the drawbacks to the use of aluminum is its scarcity, which results in making it a "near precious" metal

The detachable cylinder head which has been used for a number of years by a popular priced car manufacturer demonstrated its practicability in such a marked manner that nearly all of the newly designed engines will use the detachable head construction in connection with block motor castings.

A tendency noted in the 1916 automobile power plant design is the use of overhead camshafts and the provision of almost direct positive valve actuating mechanism. Every part of the valve system is thoroughly enclosed and all parts subject to mechanical depreciation are copiously oiled by forced or stream lubrication. Another tendency is the simplification of the power plant exterior This end is being attained by the complete enclosure of the valve operating mechanism and by the elimination of the intake manifold and those formerly used for conveying the cooling water, and in some cases even the exhaust pipe has been dispensed with.

Practically all modern automobiles are equipped with power plants of the unit type, in which the engine clutch and change speed gearing are attached together and the whole assembly supported by three points on the chassis frame This construction has survived the test of time, and experience has demonstrated that it is not only superior from the point of view of the manufacturer in reducing assembling cost, but, that it also works out to the advantage of the motorist by reducing the engine repairs necessary when the older four point suspension principle was used. The power plant suspended by three points is not affected by the unavoidable frame distortion and deflection as the more rigid supporting method is, and as the engine supporting arms need only be made sufficiently strong to support the weight of the engine, the assembly can be materially lighter than in that construction where the crank case arms must be strong enough to resist displacement of the frame members

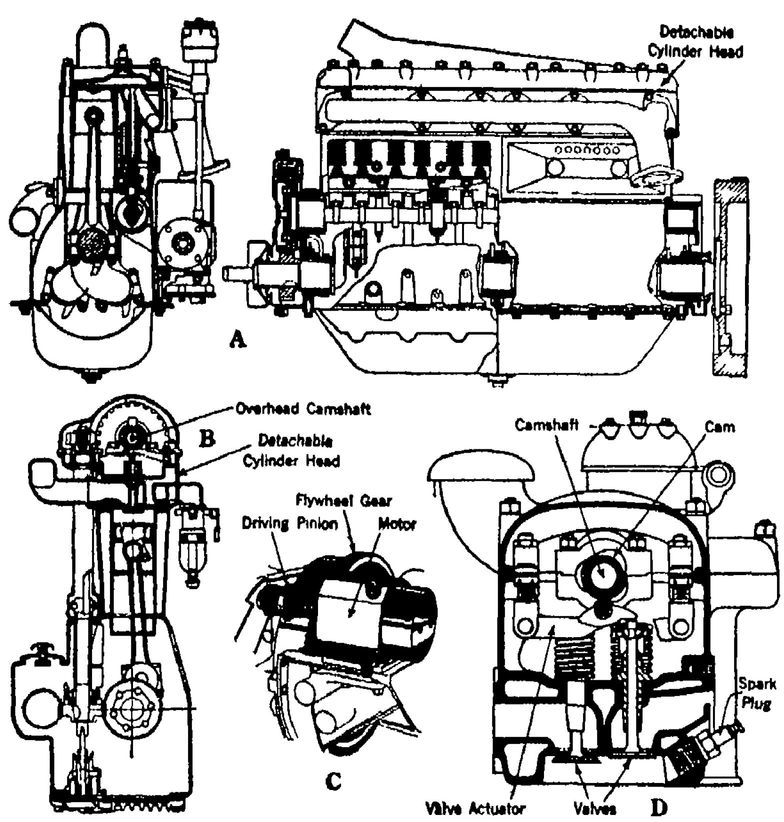
The Trend Towards Battery Current Ignition

With the universal adoption of electric starting and lighting systems has come a marked diminution in the number of firms using high tension magneto ignition Inasmuch as practically all of the lighting systems operate on the principle of keeping the storage battery constantly charged by a small engine driven dynamo, it is believed that the unfailing source of current provided in this way will result in equally energetic ignition from the battery as from the magneto The contention made by adherents of the battery ignition system, that this will provide as hot a spark as a high tension magneto will, does not ring true when one considers that designers of all the racing cars in which absolute reliability of the ignition system is essential, and in which maximum power output is required of the engine, continue to use the high tension magneto. Undoubtedly the battery ignition system produces a sufficiently hot spark for all practical purposes.

The increasing adoption of the twin four and twin-six power plant has not put a quietus on the development of the four or six cylinder forms. A notable improvement has been made in a number of cases in four cylinder motors and very smooth running obtained by counterbalancing the crankshaft throws with small counterweights forged integrally. The same favorable influence obtained by the use of lighter reciprocating parts and higher piston speeds can also be extended to the four and six cylinder forms, and when proper attention is given to the matter of valve timing and valve sizes as is necessary to secure efficient operation of the more complicated forms, the four and six cylinder motors are still forms that demand consideration.

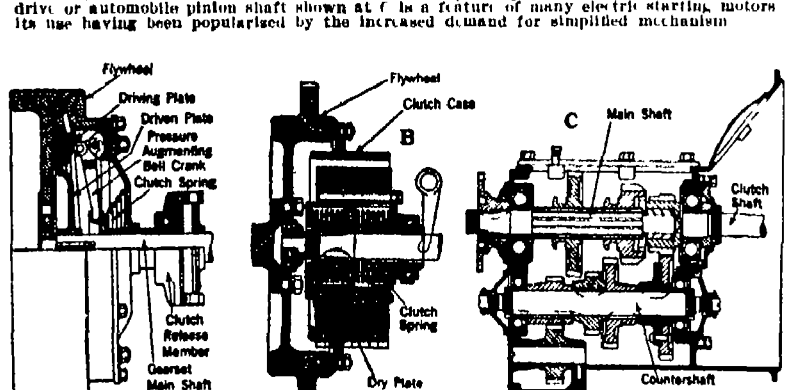
The popularization of the Knight sleeve valve motor by one of our largest automobile producers and the reduction in price of cars equipped with this motor by a number of other licensees of the holders of the Knight patent means that more motorists will be able to avail themselves of the many substantial advantages of this design Curves that have been made as a result of scientifically conducted power determination have demonstrated conclusively that the Knight type motor gives more power for a given piston displacement than any other form

Motors having L type cylinders give somewhat less power than those having T head cylinders This is because larger sized valves are made possible by the latter method of construction. Similarly, valve-in-the-head motors give more power than the other poppet valve forms, although the Knight sliding sleeve type is fully as great an improvement over the most efficient poppet valve type as that is over the other two methods of valve location



Prominent features of the 1916 automobile engine

The light weight high speed six cylinder engine shown at A is a representative form such as is supplied to furnish motive power for many 1916 medium priced cars *The overhead camshaft of the form shown at B and D is another power plant development* The Bendix drive or automobile pinion shaft shown at C is a feature of many electric starting motors its use having been popularized by the increased demand for simplified mechanism



Three-plate clutch and the multiple dry plate forms are increasing in popularity

Owing to the use of multiple cylinder motors the three speed gearset of the compact form shown at C is replacing the four speed type

Innovations in the Power Transmission System

In considering the power transmission system but few innovations have been made The spiral bevel gear, which received considerable application during the past season is being used in many more rear axles than heretofore The spiral bevel driving gearing is not only quieter than the straight bevel form but it is also better suited for the lower final drive gear ratios made necessary with the higher speed engines that are generally used in the 1916 models The doubts that were expressed relative to the durability of the spiral bevel form have been dispelled by the successful record of the 1915 cars equipped with these gears It is expected that this form will receive even more general application as the manufacturing processes are improved, making possible a reduction in initial cost to the manufacturer. There has not been the increase in the use of worm gearing on pleasure cars that was predicted, except in those propelled by electric power Worm drive gearing has become very popular, however, in commercial vehicles The reason is that the worm gear is not as well adapted for the high ratios needed in pleasure car service as the less expensive spiral bevel gear is and there is very little in favor of the worm gearing from the viewpoint of silence, though it is somewhat more efficient as a means of final drive

But few changes are noticed in clutch and gearset design There is a general tendency to use the dry plate clutches of the multiple disc and three plate forms in which one set of the driving members is faced with asbestos frictional material The cone clutch however remains popular because of its simplicity and ease of operation The multiple disc clutch having a multiplicity of plates running in an oil bath is losing ground in favor of the dry plate form The four speed change speed gear has been practically eliminated by the increasing use of lower final drive ratios and the multiple cylinder engines of the six eight and twelve cylinder forms. Three speeds operated on the selective principle are now generally used because that number is ample where a flexible motor delivering an even torque is used This has resulted in a marked compactness in gear box construction The shafts are made short and of substantial proportions In practically all cases the main shaft of the gear box is mounted on anti friction bearings, those of the ball type predominating The lay shaft of a number of moderate priced cars revolves on plain or some of the cheaper forms of roller bearings. This is not a point that tends to conserve theoretical efficiency but it is one of the steps taken to reduce cost of production The full ball bearing gear set is used by those automobile makers who still place quality and freedom from trouble above low cost of production

A great increase is noted in the use of the silent chain for camshaft operation and also for driving auxiliary electrical apparatus In all power plants where this method of drive is used greater attention is being paid to the provision of adjusting *means by which chain slack may be taken* up after the engine has been used for a time and the various links and their bearing pins have become slightly worn

Another point noticed in connection with power plant design especially in the new eight cylinder and twin six forms, is that greater accessibility of auxiliary components is provided for than was noted in the early designs This is particularly evident in the twelve cylinder forms the lesser angle between the cylinders making possible the location of the starting motor generator and ignition system at the sides or front of the motor leaving the space between the cylinders for the carbureter

Marked improvement has also been made in carburetor design duplex forms having been evolved consisting of a common float chamber feeding two synchronized mixing chambers one being used for each block of cylinders Owing to the continual specific gravity reduction and impoverishment in the grade of gasoline provided for motor car fuel the use of air stoves around the exhaust pipe connected by means of a flexible tube to the primary air intake to heat the mixture is almost universal Other features in connection with carburetor improvement are the auxiliary air control and choke valves provided to secure easy starting and in the carburetor itself the mechanical interconnection of the gasoline regulating or metering valve with the auxiliary air intake mechanism The use of a dash pot piston acting against a pneumatic cushion or in a bath of liquid fuel to steady the air valve action is also growing in popularity Most carburetors are being bolted directly to the intake passage cored in the cylinder block eliminating the inlet manifold The use of the vacuum fuel *feed system* which was first introduced last year is increasing which may be taken as an indication that its merits over the old style air pump or exhaust gas pressure feed is now generally recognized Practically all cars have the fuel tank at the rear of the chassis, where it may be easily reached for filling

Changes in Chassis Design as Reflected in the 1916 Motor Cars

In connection with chassis design the most evident point is a simplification of detail and the reduction in the number of parts used to operate the brakes or

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On the Lincoln Highway between Tahoe Tavern and Tallac, Lake Tahoe, California

Seeing America and the Lincoln Highway

Necessity of National Cooperation

By Henry B. Joy, President of the Lincoln Highway Association

"SEE America First" is a clever phrase. It is clever inasmuch as it sounds good and means or has meant little or nothing. One might just as well advise the ordinary man to "See the Moon First" or "See South Africa First" if the literal meaning of the admonition is to be attempted.

Outside of railroad trains from which one can really see or learn very little, seeing America first or last is a matter fraught with certain difficulties to those who have a nice discrimination in the matter of hotel accommodations and who value their comfort and frame of mind when at the wheel of a touring car.

But the constant iteration of the phrase is having its effect. Every year it gains in real meaning as the improvement of America's through connecting routes is advanced. The numbers who attempt to follow it grow as the possibilities of long distance touring in this country increase. The tale of the transcontinental trip is still one of interest to the sportsman or woman. For he who starts to tour America in the rough must go prepared to meet all conditions of roads, beds and food, and to him who starts out without this knowledge the words "See America First" come to have a cynical sound to be uttered sarcastically as his car sinks from under him in some rainswept bog, or as he lies down to a much merited rest between covers none too clean in an atmosphere which reminds him of home—it is so different.

As has been customary with me during the past six or eight years I took my annual vacation this year in the form of a trip by automobile to the Pacific Coast over the Lincoln Highway. Two years ago, when I made this same trip, I was doing something out of the ordinary, one perhaps of 50 tourists who took the same journey. This spring I do not believe it an exaggeration to state that I was but one out of 5,000 who essayed to reach the Pacific Coast by motor, and did reach it after a series of experiences which would make the writer of the modern popular thriller blush with shame for his lack of imagination.

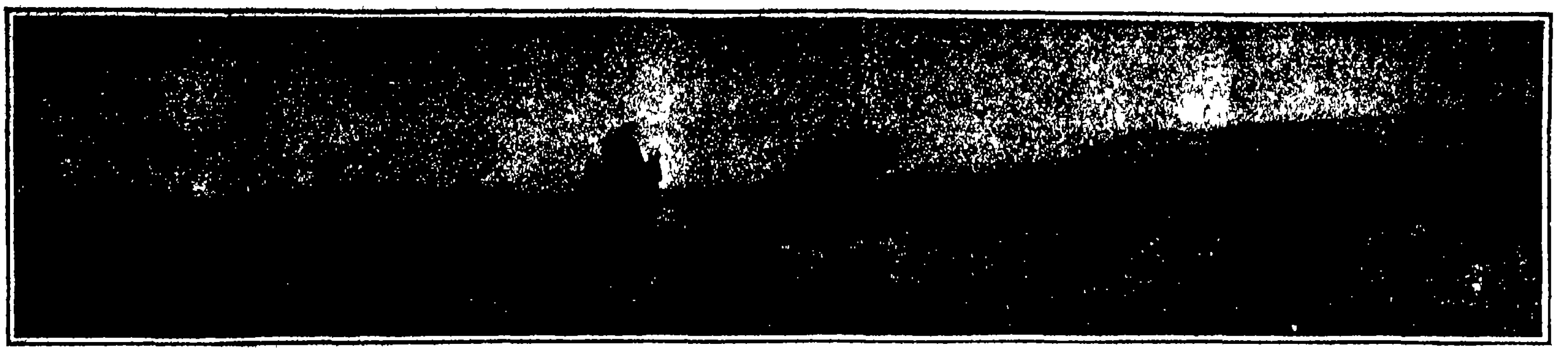
Let him who believes that romance and adventure are things of a dead past get a motor car of any make or stage of decrepitude that his pocketbook will permit and, donning his most ancient suit head his car west on the Lincoln Highway with the determination to reach "San Francisco 'or bust.'" His desire for adventure experiences, action color thrills scenery, fresh air and exercise will be well rewarded. For, let it be stated here, driving across the Lincoln Highway from coast to coast is a sporting proposition and will be for some years to come.

Stopping for breakfast on the open range west of Big Springs, Nebraska

But in following the Lincoln Highway to-day the transcontinental driver must bear in mind that he is on the first and best of the through connecting permanent routes of travel. A route which by a process of evolution during the history of the Republic has been established as the main cross-country highway from the time of the earliest settlers, with their plodding oxen to the present day. Its course has been traced in blood the effort which has been expended upon it has been prodigious. It is the best road, the only road leading from the Atlantic to the Pacific and, from September, 1913, when it was announced as the Lincoln Highway, the attention of the nation, and particularly that of the states through which it passed, has been concentrated upon its rapid improvement and constant maintenance. Yet to the man attempting to see America over this the most practical of all routes, a picture of conditions as they are to-day will be given which will send him home an active, almost militant advocate of nation wide improved roads.

The amount of work, actual improvement, which has been done on the Lincoln Highway in the past two years since the national propaganda was started, is unbelievable in its extent. To have driven the road then, and to drive it again now, is a lesson in what Americans can accomplish on an undertaking so enormous that in the aggregate it is actually beyond comprehension. And yet this work, which has been the result of the most

A Lincoln Highway "seedling mile" in Nebraska, laid with cement contributed by the Association



On Nevada's desert wastes the modern motorist frequently encounters the creaking prairie schooner of an earlier day

exhaustive efforts of the people along the route, is seen to be such a small proportion of the tremendous force necessary to accomplish the task to which the people have set themselves, that the necessity for a *national* coöperation is appreciated.

The West is America's great natural playground. From this great, bounteous healthgiving wonderland of far spaces, glorious scenery, revitalizing air and inspiring vistas of mountain, stream and forest, the crowded population of our East and Middle-West is shut off when it rains by one of the most effectual of barriers—mud. It has been so long and so completely shut off to all excursion and exploration except by rail, that people, forgetting that it is there, have, after exhausting the possibilities of the East, followed overseas to the much exploited, easily accessible, but in reality inferior pleasure places and beauty spots of Europe. With them in the past has gone, never to return, an annual contribution to the prosperity of Europe, which has been expertly estimated at over $200 000 000. This year, with the doors of Europe shut with a mailed fist in the faces of American pleasure seekers, our home resources have been fallen back upon. Our Pacific Coast with its two expositions beckoned the motorist to the beauties of California and thousands answered the call.

To travel by motor car across Indiana, Illinois, Iowa and Nebraska, those great farm states where much of the wealth of the nation originates, during or just after a heavy rain, is to all intents and purposes impossible. If it rains you stop where you are, or in the nearest town you are lucky enough to reach, until it stops raining and the roads have dried off and been again dragged to that boulevard smoothness which characterizes the Lincoln Highway in dry weather. That is if you are on a pleasure trip you stop. If you are accustomed to hardship and are making a business of getting through, as I was this year, you may go on, making perhaps twenty five to thirty five miles a day with a prodigious expenditure of gasoline and effort, driving eighteen hours out of the twenty four, constantly sunk to the running boards in a mud called gumbo, which is unknown to our East, and which has been characterized as being eighty per cent pure glue. You can go on, wet, cold, sleeping when you can in ditches or wherever you may happen to be stuck when night falls, eating when you can of anything edible procurable at luncheon counters or mediocre restaurants and subjecting your car to a usage which ordinary driving would not give it in years.

There are not many people who will do this. In fact during the terrible rains of late May and early June of this year all across the Middle West, our party was practically the only one in motion and I was not primarily on a pleasure trip.

Yet the Lincoln Highway is bringing better accommodations along with better road conditions. Increase in tourist traffic alone warrants the proprietors along main routes of travel in bettering the conditions. With any luck, you can sleep in a bed every night of your journey between New York and San Francisco, but you must not be squeamish if you want to do it. Two years ago the transcontinental driver prepared to camp out every night after he got west of Omaha, Nebraska.

The change in conditions is shown by one typical instance. Far out on the edge of the Great Salt Desert south of Great Salt Lake, where the Lincoln Highway clips a cautious edge from the American Sahara, stands one of those ancient stone structures built as a station for the pony express riders back in the days immortalized by Bret Harte and Remington. The old transcontinental trail is dotted with these relics of a day when mail was relayed by daring riders and sweating

The author directing operations "on the ground" in Iowa

ponies from St Joseph to the Golden Gate. Every ten miles of the western journey brings to light one of these crumbling stone huts. The one at Fish Springs, Utah, differs in that it has been continuously occupied and kept in repair since 1853. It is now owned and has been for forty years by a character as typical of the old West as the building he occupies. Fish Springs, Utah, consists of J. J. Thomas's ranch. J. J. Thomas has lived on this ranch, surrounded by salt flats and plains of volcanic dust and rock, for fifty years and he is as hale and hearty to-day as in the days when Horace Greeley stopped when following his own memorable axiom, "Go west, young man, go west." Here the greatest and least have stopped and supped on their way across the desert, here Mark Twain partook of the same fried eggs and good white bread, teamed then as now 80 miles across the desert behind ten dusty mules. J. J. Thomas has seen the evolution of the West as no man has. All must stop at his hospitable gate.

What has the Lincoln Highway done for Thomas? Ask him and he will show you careful records which reduce to the simplest terms the development which is taking place in like measure along 3 400 miles of road. Read the pencilled figures in the big account book. Cars passing in June 1913—52. Cars passing in June 1915—225. An increase of over 400 per cent in two years.

The night we stopped there this summer gave the answer. Eighteen people were gathered in the little stone express station. Six cars stood outside. One was from Oklahoma, one bore an Indiana license, a third was from Salt Lake City, two came from California, ours from Detroit. All but our party stayed for the night in the building which increasing business has forced Thomas to add at the rear. We all took supper, we all bought gas and some oil. And every drop of that gas and oil, every crumb of that dinner, every plank in those buildings were brought by those same ten mules from the nearest railway—80 miles.

This is but one angle of what the Lincoln Highway means to the West. Innumerable examples could be given. The answer to this one is clear. Thomas is making more money than he ever saw before, and he and others in the same position, whether on the desert or in the city, are good enough business men to realize what has caused this tremendous increase in revenue, and are spending part of it in the further improvement of the road and in bettering the accommodations which must be *offered* to tourists. This is going on all along the line in varying degree from New York to San Francisco.

The eastern end of the Lincoln Highway, like eastern roads in general, does not present much of a problem. You can drive to-day from 42nd St. and Broadway to Chicago in 35 hours of driving time if you want to push your car. It is in the middle and far West that the question of road improvement is a serious one. The Lincoln Highway in New Jersey may be considered perfect, the Pennsylvania section is in the main good hard surfaced road, well kept, but a few miles of the Lincoln Highway in Ohio remains to be hard surfaced. I have driven this section of the Lincoln Highway many times and so this year my trip over the route started at Elkhart, Indiana. From that city west to Oakland on the Golden Gate I did not drive 50 consecutive miles without encountering either actual road work in progress or sections of road which gave certain indication of having recently been worked. I know positively that I must have passed 5 000 men at work on the Lincoln Highway during the 23 days of my trip. I was impressed with the tre-

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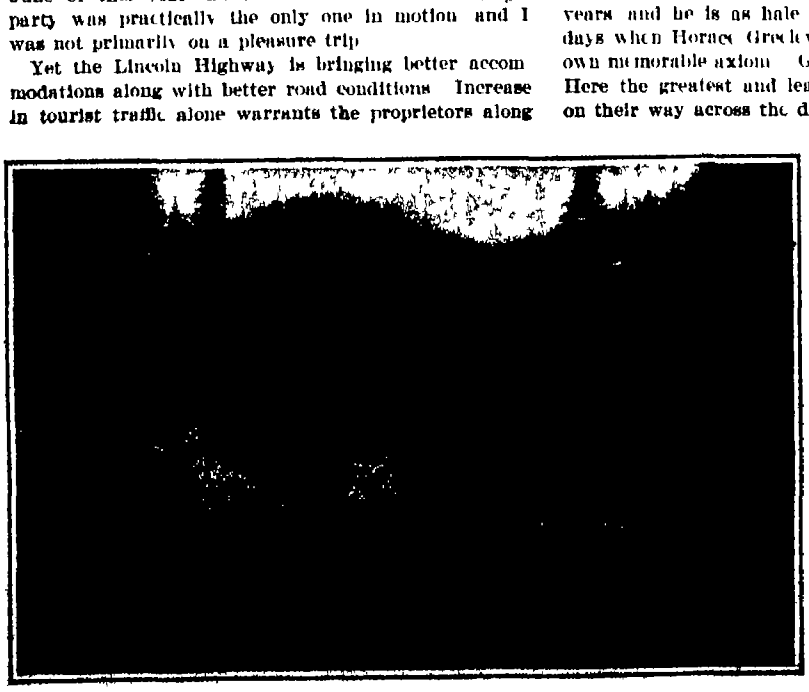
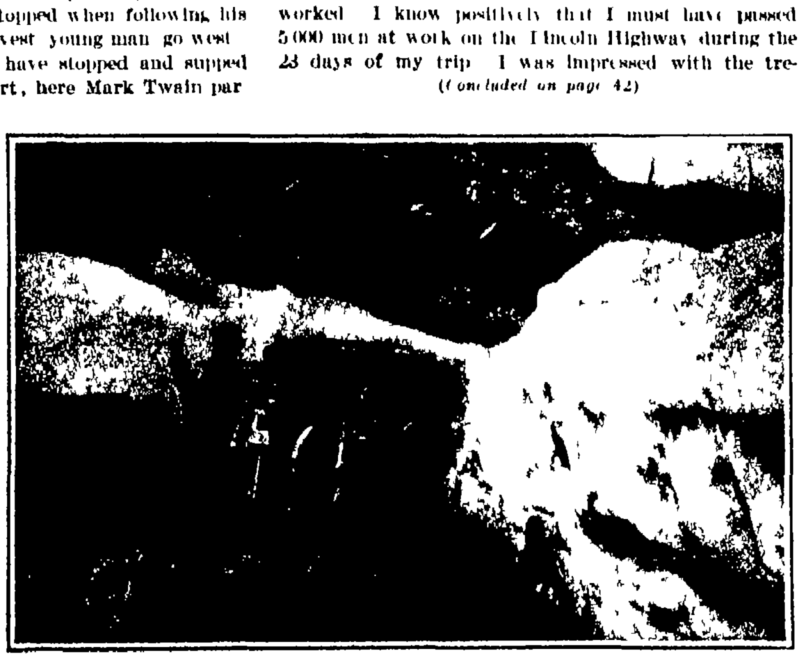


Following the Truckee River between Truckee and Tahoe Tavern



Stopping amid the snow banks of the Sierras before dipping down into sunny California

First stage in the manufacture of leather skins entering soaks

Removing hair after depilating treatment

Bating the skins to produce a soft and open condition

The Effect of Technical Education Upon the Leather Industry

How the Tanning Industry Has Benefited Through the Application of Science

By Allen Rogers, Ph D

[*Impelled by the exigencies of the war the United States has ventured into new lines of industry or is considering the advisability of doing for itself many things that were formerly considered beyond its reach. Before us lie opportunities such as we never dreamed of. Dare we seize them? Can we hold them after the war? Can we meet the keen competition that is sure to arise when the vast European armies return to their homes and to their bread-winning tasks? How may we in time of war prepare for peace? These are burning questions.*

THE SCIENTIFIC AMERICAN *urges a campaign of Industrial Preparedness for Peace. We are planning to publish helpful articles on our opportunities and how they may be realized; on our wonderful resources and how they may be developed; on our manufactures and how they may be improved; how we may eliminate waste of material and waste of effort.*

The following article tells the story of the practical cooperation between the National Association of Tanners and Pratt Institute. It should be an inspiration to other lines of industry, pointing out as it does the benefits that will accrue from a closer association of our industries with our educational institutions. Many of our industries are suffering from a lack of such cooperation. We urge them to enter upon a higher plane of efficiency by means of scientific research.—ED.]

IN an article entitled "The Technically Trained Foreman," which appeared in THE SCIENTIFIC AMERICAN of September 16th, 1911, the writer described at some length the course in Applied Chemistry as conducted at Pratt Institute. In the article reference was made to the coöperation with the National Association of Tanners, but at that time the affiliation of the school with the industry had only just been consummated, so that little could be said as to the benefits that might accrue.

After five years it is now possible to give the reader some idea of the results of practical experience, which it is hoped may serve as an incentive for other lines of chemical industry to take the matter of technical education under more serious and extended consideration.

To gain a somewhat clearer idea of what has been accomplished, let us look back upon the history of the undertaking and then follow step by step the course of events which has led to the establishment of this very novel and efficient method of instruction.

In September 1905 when the writer accepted the position at Pratt Institute to take charge of the Industrial Chemistry, he was well aware of the conditions in the leather trade and therefore, in making plans for the industrial laboratory, provided among other equipment for practical instruction in tanning. The layout at that time consisted of a small mill and paddle and three small pits, the floor space for which occupied fifteen feet by five feet. It was little thought, however, at that time that this embryo tannery was destined to become the largest and most completely equipped school tannery in the world. During the years 1905 and 1906 several articles by the writer appeared in the *Shoe and Leather Reporter*, as a result of which two young men applied for admission to the school for the purpose of specializing in leather. Further articles appeared in this and other trade papers and in *The Journal of the American Leather Chemists' Association*, all of which may have had a tendency to create interest in the undertaking.

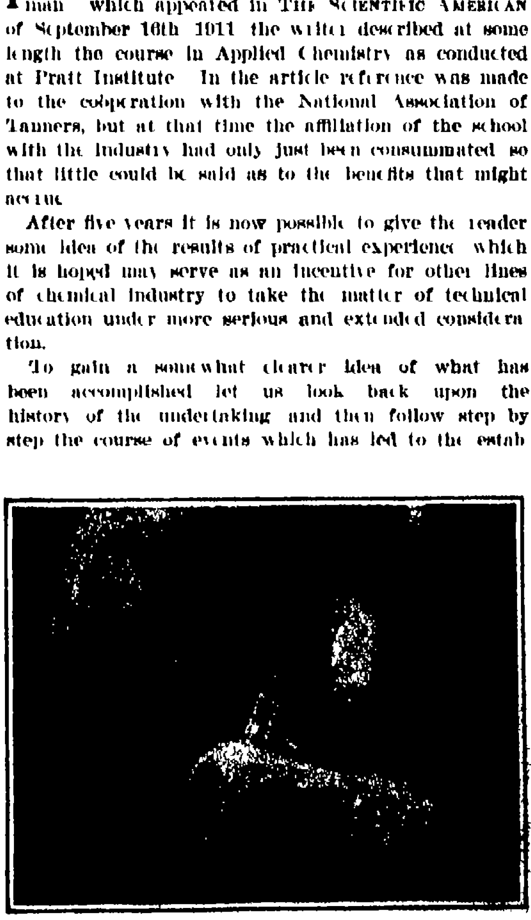
Each year a few men entered the school for the purpose of making a special study of leather, and in 1909 it became apparent that the marked growth along this line would warrant a little extension of the equipment. Two machines were therefore added, consisting of a rolling jack and a set of buffing wheels, the floor space being extended to fifteen by fifteen feet. The classes of 1910 and 1911 were thus provided with better facilities for practical instruction than were the previous classes.

At the end of five years from the founding of the course in applied chemistry, the first epoch in the development of tanning instruction in America, there were about eighteen graduates at work in tanneries throughout the country, all of whom were holding positions of responsibility and trust. The good work had thus been started and a certain amount of progress made.

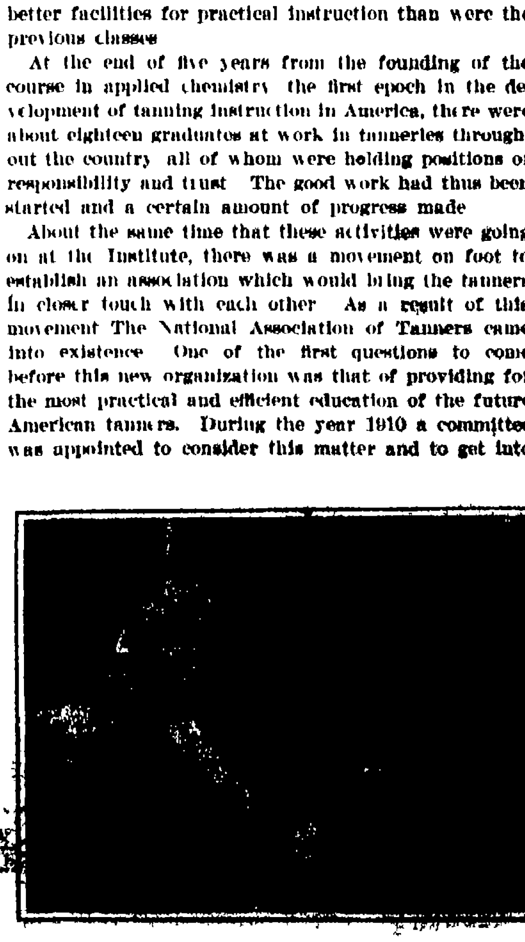
About the same time that these activities were going on at the Institute, there was a movement on foot to establish an association which would bring the tanners in closer touch with each other. As a result of this movement The National Association of Tanners came into existence. One of the first questions to come before this new organization was that of providing for the most practical and efficient education of the future American tanners. During the year 1910 a committee was appointed to consider this matter and to get into touch with educational institutions. To cut a long story short, the committee eventually visited Pratt Institute, and was so impressed with the work already being done that it unanimously voted to enter into a five-year agreement. Pratt Institute for its part, was to provide the building, equipment and instructors. The National Association of Tanners to furnish sufficient funds for scholarships, inspection trips, outside lecturers, publicity and investigations. This extension of the work made it necessary to increase the equipment, so that the floor space was again enlarged to twenty by eighty feet, more and larger mills, paddles and pits were provided, and a number of new machines added. It should be said in passing that several of the new machines were donated on an indefinite loan by the manufacturers of the machines.

Having made the necessary provision and arrangements for the practical instruction, the question as to the character and scope of the instruction was next considered. This phase of the problem was left very largely to the judgment of the Institute, and when the plan of procedure was suggested it met at once with hearty endorsement from the association. The proposition was to provide for two courses, one of which was to be known as the Tanning Course. This course would aim to fit young men for practical positions in the plant, such as foremen or heads of departments. In the conduct of the course would be included only those subjects which would be directly beneficial to the man in the works. In other words, the technical instruction should have a direct relation to the practical operation. The other course of instruction, to be known as the course in Applied Leather Chemistry, was to be open to young men who had already graduated from an approved course in chemistry. In this course they were to be given more advanced chemistry as applied to leather manufacture, and were to become familiar with the practical side of the industry. By this means it was thought that they would become more efficient leather chemists.

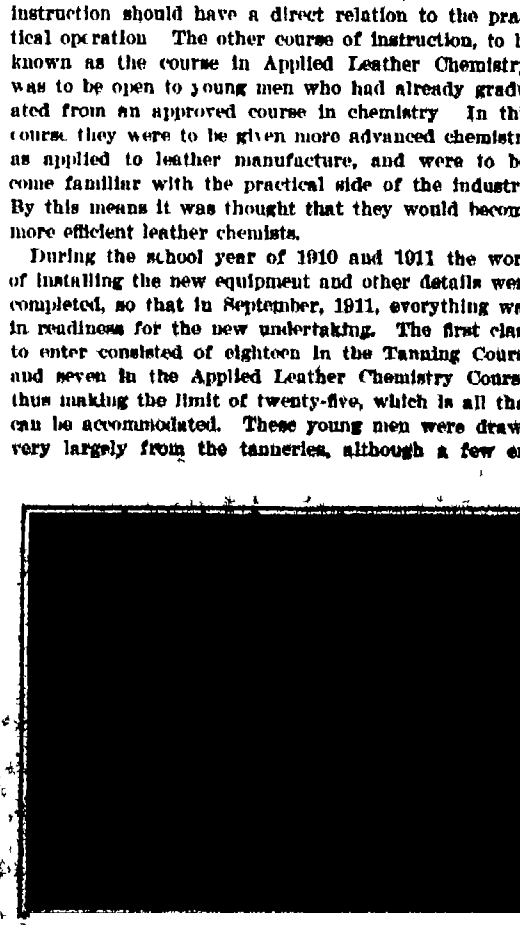
During the school year of 1910 and 1911 the work of installing the new equipment and other details were completed, so that in September, 1911, everything was in readiness for the new undertaking. The first class to enter consisted of eighteen in the Tanning Course and seven in the Applied Leather Chemistry Course, thus making the limit of twenty-five, which is all that can be accommodated. These young men were drawn very largely from the tanneries, although a few en-



Chrome tanning



Shaving the skins before coloring



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trained who had no previous practical experience. It may be of interest in passing to mention that one of these men who had never even been inside a tannery before entering the school is to-day assistant superintendent in one of the largest sole leather tanneries in the country. Four classes have been graduated from these courses, and of these graduates over eighty per cent are at present employed in the trade. They are holding positions which range in responsibility from assistant foremen, foremen, assistant superintendents, superintendents, chemists, and even managers of plants. As a matter of information it might be mentioned that of those not employed in tanneries about half of them are from the first class. The demand for these young men has been on the increase each year, while more concerns are sending their promising young men to take the courses offered. This latter state of affairs is very gratifying, as it shows that the manufacturers are interested. When the factory sends a man to school and, as is often the case, pays his expenses, you may rest assured that they expect to get a full return for the money invested. Whether or not it has been a paying investment may be judged from the fact that several concerns have sent more than one man. One concern, in particular, had a man in each class for three years and are to send two men next fall. The three men from this plant are now holding superintendent positions in three of the numerous tanneries controlled by this organization. Not only are the manufacturers sending men from their plants, but many of them are sending their sons to take the courses offered.

In the development of the chemical courses it seems that radical changes are apt to take place at five-year periods. This year, which marks the fifth year of the special tanning courses and the tenth year since the inauguration of the chemistry course, opens up another epoch in the growth of the Institute in its relation to the leather trade. The changes of the present year are due to the fact that the equipment provided in 1910 and 1911 had become inadequate for the demands placed upon it. More room, therefore, has been made available, so that the new tannery, which has been installed by the students themselves, when completed, will occupy a floor space of 40 by 100 feet. More pits, mills, paddles and machinery have been added, so that when the work is finished we will have in this country a school tannery which will be second to none in the world. This new arrangement gives a capacity of 100 dozen skins and one dozen hides per week. The larger output, which is already in operation, will give more and better experience than it has been possible to obtain in the past.

That the courses provided by the Institute have met the requirements of the industry and that the National Association of Tanners feels satisfied with the results already accomplished is shown very conclusively by developments which are now under consideration. These latest developments have to do with the establishment of a research laboratory to be conducted in conjunction with the tanning courses. The plan already adopted provides for a thoroughly equipped laboratory, which will be under the direct supervision of the best leather chemist it will be possible to secure in the world, who will devote his entire time to the study of such problems as are of general interest to the industry. To carry out the work on a sufficiently large scale he will have as his assistants two graduate chemists and a bacteriologist. One of the requirements of the assistant chemists is that they should have first taken the course in Applied Leather Chemistry. The financing of the undertaking is entirely in the hands of the National Association of Tanners, and that sufficient funds are available is already assured.

The establishment of this laboratory is very significant in pointing out a future policy, which not only applies to the leather industry, but which no doubt will be taken up in other lines of manufacture. This industry, however, has brought to a successful issue the establishment of special courses for the betterment of the factory conditions, and is now about to venture upon a new enterprise which aims to promote and develop the industry by means of extensive research work and scientific investigations. What the future has in store for the American tanner remains to be seen. We cannot help but feel, however, that we are on the right road, and the future certainly does look promising.

In closing this article the writer would like to point out that the phenomenal success of this undertaking is due to the hearty coöperation of all concerned, which includes The National Association of Tanners, Pratt Institute, the American Leather Chemists Association, the various trade and scientific journals; the manufacturers of machinery, extracts, oils, chemicals and dyestuffs; the graduates from the courses and the students themselves.

The Motorboats of the Volunteer Patrol Squadron

VERY much like the Plattsburg movement, the Volunteer Patrol Squadron is the first real substantial move of private individuals to train themselves for a naval reserve in this country. The organization is an association composed of, at the present time, five 40-foot boats, with a crew of four men to each boat, each crew to consist of a captain, two signalmen and one engineer; also the commander of the squadron, who is Mr. Stewart Davis of South Hampton, Long Island, N. Y., a squadron quartermaster, a squadron surgeon and a supervising engineer. All are members of the association, and all serve without pay and pledge themselves to one month of actual duty with the squadron every year, besides being subject to calls from the commander at any time, either in winter or summer.

The boats are about finished now, with the exception of the installation of the engines, which are on their way to the yard, so that they will be ready and in commission the first of the spring, when it is proposed immediately to take a trip south through the canal to Washington and the Chesapeake, illustrating there by just how quickly a fast fleet of dispatch or patrol boats can cover the distances along the coast.

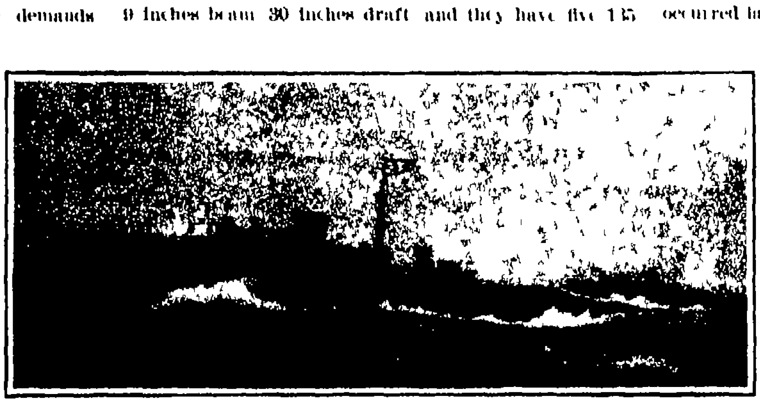
Except for the month that the squadron is together the boats will cruise separately, being assigned by the commander to different stations along the coast, and when the fleet goes out of commission they will be kept at all times with everything ready, so that they can be put in commission at a few days notice. Some special work has already been decided upon for the squadron, which will be published at a later date.

These boats were designed by Mr. A. Loring Swasey, the construction engineer of the fleet.

Their general dimensions are 40 feet over all, 8 feet 9 inches beam, 30 inches draft, and they have five 135 h.p. engines, which will give them a speed of 23 to 24 miles an hour at sea. They are also built in case it is found necessary, so that their speed can be increased to 30 miles an hour by the substitution of larger engines.

A separate boat is already being built with the squadron for the purpose of demonstrating the higher speed of 30 to 32 miles an hour with the larger engine in a hull of the same design.

The design of these boats was decided upon owing to the remarkable speed and seagoing qualities of the 40-foot Hoop-La, built last season, which yacht has had a number of very severe trials along the coast and was found to exceed all expectations in her wonderful seagoing qualities and smartness under all conditions. Before this boat was built it was hardly believed possible that boats of this type could live in the ocean in a bad storm, but with their special construction it was found that they were more seaworthy than the larger and heavier boats.



Boats of the first Volunteer Patrol Squadron

Cereal Dust Explosions

THE various dusts made in the handling and working up of grain into food products are not only inflammable, but also more or less explosive, and have given rise to many serious accidents. These occur in cereal, flour and feed mills, grain elevators, starch and glucose factories, and on farms, in connection with the use of threshing machines. In view of the growing number of such accidents, an investigation of the conditions under which they occur has recently been undertaken coöperatively by the U. S. Bureau of Chemistry, the U. S. Office of Public Roads and Rural Engineering, the U. S. Bureau of Mines, and Pennsylvania State College. Some results already obtained in this investigation were reported by Mr. D. J. Price of the Bureau of Chemistry, in an address before the convention of the Fraternity of Operative Millers of America, at Cincinnati, May 26th, 1915.

Mr. Price presented an analysis of a series of explosions which have occurred since 1905, and in which at least 80 men have been killed, 125 injured, and property destroyed to a value of more than $2,000,000. In eight cases the explosions seem to have been due to sparks produced in the machines during the grinding process; one was attributed to static electricity, while ten arose from unknown causes.

The present and previous investigations indicate the following causes of such explosions: 1. Introduction of foreign materials into grinding machines (such as particles of gravel, flint, metal, etc., which may produce a spark when coming in contact with the plates of the machine). 2. Use of open lights or naked flames, such as oil lamps, torches, gas jets, matches, etc. 3. Property fires. 4. Electric sparks from motors, fuses, switches and lighting systems. 5. Static electricity, produced by friction of pulleys and belts, machinery parts, grinding machines, revolving reels, etc.

For the sake of studying the dangers arising under heading No. 1 an experimental mill has been installed at Pennsylvania State College. It is hoped that definite knowledge may thus be obtained regarding the relation between sparks produced by foreign substances in the machines and a suspended dust cloud. An important question relates to the amount of dust necessary to propagate a flame. It is believed that a sack of flour suspended as dust in 1000 cubic feet of air (equivalent to the capacity of an average room in a dwelling house) would, if ignited, produce an explosion sufficient to throw 2,500 tons 100 feet high. It appears from preliminary experiments that many cereal dusts have lower ignition temperatures and produce higher pressures than coal dusts.

In connection with explosions due to static electricity it is worth noting that these have been prevented in some cases by the expedient of grounding the grinding machines. Experiments have shown that the friction of a very small pulley and belt will produce enough static electricity to ignite natural gas.

The disastrous series of fires and explosions which occurred last season in threshing machines in the northwestern states involved a loss aggregating at least half a million dollars. These fires, which were attributed to smut dust, were described in the SCIENTIFIC AMERICAN of January 23rd, 1915, page 79. The U. S. Department of Agriculture undertook an investigation of this subject during the past summer.

Chemical studies are now under way to ascertain what factors especially determine the inflammability of the various cereal dusts, involving the relative importance of the amount of volatile matter in the dust, the percentage of moisture and ash, the rate or ease of oxidation and the fineness of the dust.

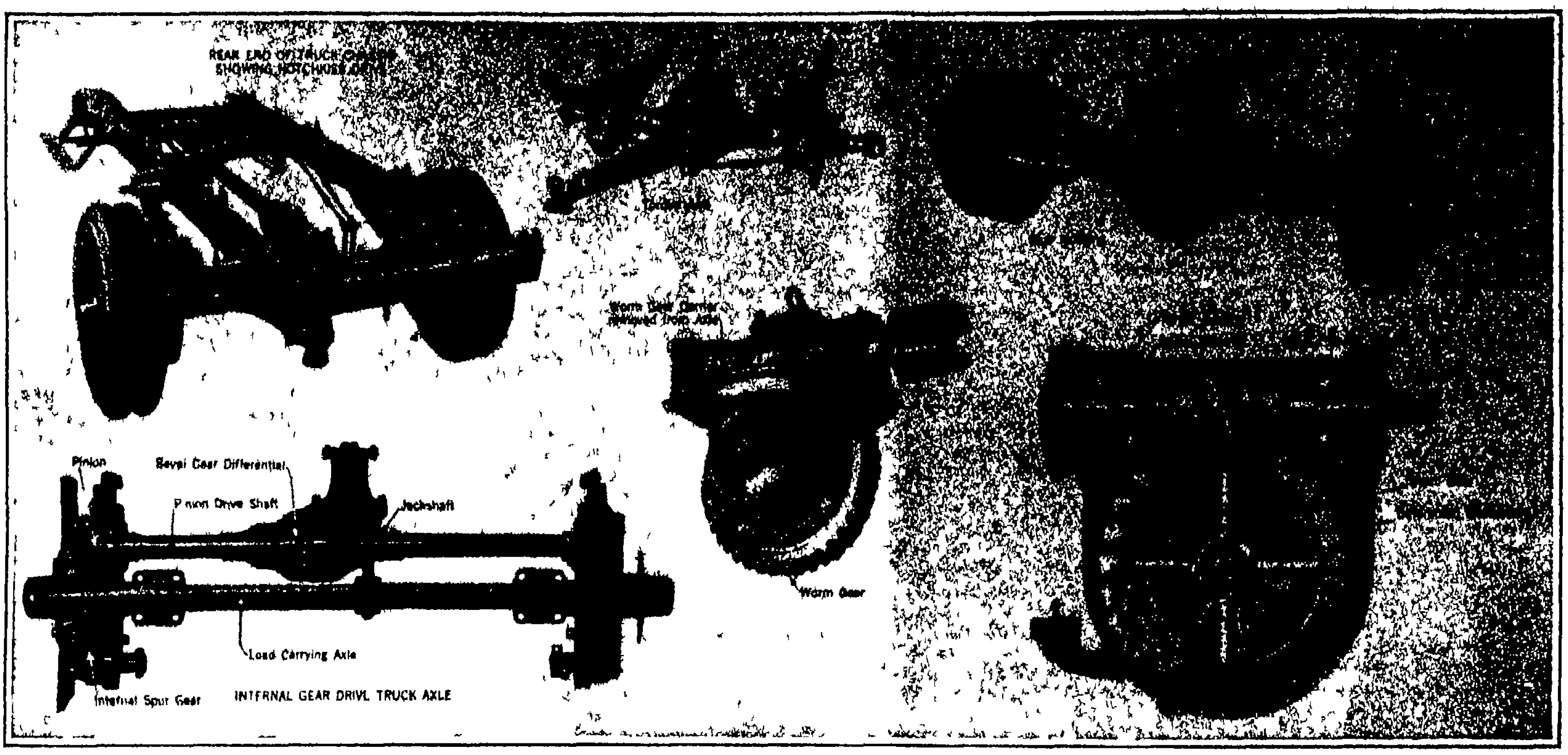
The principal precautions thus far suggested are: Avoid the use of gas jets and the practice of lowering lanterns or open lights into grain bins or dust-collecting systems. Do not allow dust to accumulate unnecessarily. Electric lamps exposed to danger of breakage should be enclosed in wire guards. Fuses, switches, starting boxes, motors, etc., should be located so far as possible in places where dust is not present. Grinding machines, pulleys and shafts should be grounded to carry away static electricity. Small bins limit the possible violence of explosions.

Trouble with Fusible Tin Boiler Plugs

BOILER plugs are set in the wall of a boiler about one inch above the danger line of low water. As long as they are surrounded by water they remain solid, but when the water falls below them the temperature rises to the melting point of the plug, usually tin, and the steam blows off. Too frequent boiler explosions caused the U. S. Bureau of Standards to investigate a thousand plugs, 100 having seen some months service. A startling number were filled with a close network of tin oxide, whose melting point is much higher than that of tin and too high for a safety device. Analysis showed the presence of from three-tenths to four per cent of zinc. The zinc was corroded by boiler water softened with too much soda and oxidation of the tin was then rapid. Pure Banca tin will not oxidize.

Gives Claims Broadest Interpretation

THE Court of Appeals of the District of Columbia, speaking through Justice Robb in Kirby v. Clements, says: "In an interference proceeding we must give to the claims the broadest interpretation which they will reasonably support, and we are not at liberty to import limitations therein to meet the exigencies of a particular situation. The reasonable presumption is that an inventor intended to protect his invention broadly, and consequently the scope of a claim in an interference proceeding should not be restricted beyond the fair and ordinary meaning of the words."



A collection of views showing the construction of worm-drive and internal-gear-drive truck axles and the method of application to the chassis

Development in Commercial Vehicle Design

Prominent Features and Tendencies in Present-Day Motor Truck Design

THE growth of the motor truck industry has not been as spectacular as that of the pleasure car, neither have improvements in design been heralded so widely. The development of American motor truck design can not be said to have reached finality nor has it become generally standardized. Considerable difference of opinion still exists regarding the best type of truck to be used and widely diversified designs are offered the purchasing public. There is one point, however, upon which practically all truck makers agree and that is in the main chassis design which is now patterned largely after European practice.

When the motor truck industry was in its infancy in this country it was established on a firm basis abroad notably in England and France. The first motor truck built in this country had the power plant placed under the body which time proved to be poor practice as is also the construction in which the driver sat on an elevated platform under which the power plant was placed. At present practically all American trucks have the motor compartment in front of the driver's seat just as in pleasure car practice and in accordance with the system of construction which is universally used abroad.

Accessibility of the Power Plant

Power plant accessibility is an important item in a commercial vehicle because the factor of lost time must be reduced as much as possible. Truck manufacturers have not been slow in realizing that a relatively inaccessible power plant is apt to be neglected. When it is placed at the front end of the chassis under an easily removable hood there is no excuse for neglecting the periodic inspection, cleaning and lubrication that are necessary to maintain power plant efficiency. Other engineering features that have been found practical in pleasure car application have in turn been applied to truck construction. A conspicuous example of this development is found in the adoption of the unit power plant and of the entirely enclosed final drive systems.

New Final Drive Systems and Their Advantages

Considering first the development of the final drive system because this is really the most marked divergence from previously accepted truck standards we find that the completely enclosed final drive systems provide a method of power transmission that is claimed to be in every way superior to the jack shaft and double side chain and sprocket drive. While the latter method of power transmission was very efficient when new, it was apt to be neglected by those who had charge of the upkeep of the trucks with a result that depreciation was rapid. In most designs the chains were exposed because of the difficulty involved in enclosing them in a simple and practical manner. Unless the chains were kept constantly lubricated and were cleaned at frequent intervals, they were apt to depreciate rapidly and this deterioration of the sprocket teeth and chain links resulted in extremely noisy operation as well as inefficient power application.

During the first few years or what we may call the development period of the American industry it was natural to expect American engineers to follow closely the work of the foreign builders and inasmuch as the field of British development was the easiest to study it was to be expected that many of the features of design that had proven practical in England would be adopted in this country. It is to the influence of the English designers that the popularity of the worm and worm gear driving system can be traced. Police regulations abroad were such that noisy trucks were barred from the streets. The rules established by the larger English municipalities, especially London, were so drastic that many double-chain driven omnibuses were condemned by the authorities because they could not be made to conform with regulations.

Experience with worm gearing developed a form of gear drive that was not only remarkably enduring but which was silent in operation and which did not become noisy in service. The completely enclosed worm drive was also found to be more reliable in the hands of the average motor truck operator than the chain drive it superseded. The importance of having a "meddle-proof" construction cannot be overestimated when one considers that many companies who disposed of their horses and wagons in favor of motor vehicles employed mechanically inexperienced drivers for operating their trucks. This was the logical thing for these firms to do inasmuch as their old drivers were undoubtedly more familiar with their peculiar business conditions than new and perhaps more mechanically proficient employees would be.

It is stated that the London General Omnibus Company has operated something like 3 000 large worm driven busses on the streets of London and has found it utterly impossible to strip the gearing, due to the unusually strong form of tooth presented to the high tooth pressure necessary in driving these heavy vehicles. As far as endurance is concerned, it is important to note that an average of 80 000 miles has been covered before any appreciable wear was discernible in the worm gears.

Worm gearing is not only enduring and noiseless, but is remarkably efficient, as actual tests have demonstrated that from 90 to even as high as 97 per cent of the horse-power applied to the worm driving shaft has been delivered to the road wheels. The sectional view in one of the accompanying illustrations clearly shows the method of supporting the worm shaft by anti friction bearings and the way the worm gearing is applied. In all cases the worm is made of hardened steel and is either triple- or quadruple-threaded, having a lead angle sufficiently acute to provide the factor of reversibility, which is essential in automobile service. To one familiar with mechanics it will be apparent that, while it is possible to exert great power and secure a great ratio of speed reduction with a gradual pitch worm, the construction would be almost irreversible. This factor of irreversibility while very desirable in such mechanism as automobile steering gears would not be practical under those conditions where the worm wheel must become the driver as in coasting.

The worm gear assembly which is ordinarily combined with the differential gearing is nearly always attached to a carrier member which fits into the main axle housing. Such an assembly is shown just above the sectional view of the worm gear. The reason for this construction is that it is essential that the worm gearing be accurately adjusted and that this adjustment be maintained. It is not only important that the worm should mesh properly, but the center line of the worm must coincide exactly with the center line of the worm gear or considerable friction and actual depreciation will ensue. It was fortunate, indeed that in the automobile applications the gear ratios desired ranging from a reduction of 8 to 1 in the lighter trucks to 15 or 16 to 1 in the heavier vehicles, were not so low as to demand gradual pitch single-threaded worms. As the worm gearing is invariably carried in a casing that may be filled with lubricating oil, and as there is no opportunity for grit or dirt to enter, it will be apparent that long life is assured.

Another form of final drive system that is receiving considerable attention at the present time is a double reduction axle of the type in which a primary reduction in speed is obtained between bevel gears, while a secondary and final reduction in speed is secured by driving the wheels through the medium of internal gearing. It is conceded that internal spur gearing is the most efficient form and when it is applied properly to rear axle construction one obtains advantages that are worthy of consideration. An internal gear-driven axle, as can be readily ascertained from inspection of the part sectional view, is a form in which the jack shaft, which is ordinarily placed on the chassis frame in the chain and sprocket drive system, is attached to the axle—in this instance a non rotating member on which the wheels revolve freely. Instead of sprockets at the end of the live axle shafts small spur pinions are mounted which mesh directly with the large internal gears bolted to the brake drums, which in turn are securely fastened to the wheel hubs. The worm axle is a built up form and must be made very strong because the housing for the driving gearing and axle shafts must be heavy enough to carry the load as well as enclosing the transmission members. On large capacity trucks, a live axle construction becomes of necessity very massive and correspondingly heavy.

Reduction of Unsprung Weight

It is considered good engineering practice to reduce the unsprung weight of any motor vehicle as much as possible, as this lessens tire and mechanical depreciation. While it is considered essential to use light rear

axles in pleasure cars, this is necessary on account of the high speed these vehicles are capable of attaining. The live axle construction on a pleasure car is not stressed as much as the similar construction would be on a truck because it is supported by relatively light wheels provided with pneumatic tires. This argument of minimum unsprung weight is advanced by those engineers who favor the internal gear drive axle. It is said that the load-carrying axle can be made very strong without being heavy as this need not be anything more complicated than a solid round or square bar of standard cross section, and if made of chrome or nickel alloy steel it need not be large in diameter. It is also possible to considerably reduce the weight of the jack shaft. When this is mounted on a chassis it must be strong enough to withstand some of the unavoidable twisting to which the motor truck frame is subjected. When mounted directly on the axle the only consideration is that the jack shaft be strong enough to transmit the power since it is not subject to any other strain.

Another advantage in favor of the internal gear drive system is that it provides more ground clearance than can be obtained with worm drive axles even those of the overhead worm type. On the other hand owing to the employment of three sets of gearing for transmitting power instead of one set, as in the worm driven axle, its efficiency is not as high as that of the worm and worm wheel.

A tendency noted in connection with final drive systems is the simplifying of the truck chassis by eliminating radius rods and torque members that were formerly required with the side chain drive systems. When the worm drive axle is used, only one torque rod is necessary if that construction is followed as this is usually mounted so its center line coincides with that of the worm gearing as illustrated. This one member which is of substantial cross section, may take the place of four that were required in some cases with the chain drive axles. Experience has demonstrated that by paying proper attention to spring design no torque or radius rods are needed as not only the driving but also the braking torque can be properly taken care of by the springs if these are of suitable proportions and mounted correctly. This provides the Hotchkiss drive which is now becoming so popular on pleasure cars.

Constructional details of wheel, axle and change speed gearing of four-wheel drive, steer and brake truck

Four-Wheel-Drive-and-Steer Motor Trucks

About three years ago or two years before the start of the great European War the United States Government concluded a series of exhaustive tests on motor trucks for army use. While the rear drive truck of commerce proved adequate for doing much of the work incidental to army transport service its efficiency was found to rapidly decline when the highways were poor or entirely lacking as in cross country work. The standard four mule army team was taken as a basis of what a motor truck should be able to accomplish. The result of this development which was made with the cooperation of the engineers of a pioneer automobile manufacturer was that the Government experts decided that the four wheel drive principle was the only system of power transmission capable of doing all of the work demanded of a motor truck on the field of battle as well as in the more prosaic duty of transporting supplies. A truck was evolved in which all four wheels were dirigible for steering and were also driven by the engine power. A special form of differential was used that differed from the conventional type in that it delivered the power to the wheel or wheels that had the most traction instead of to those having the least traction as accomplished by the ordinary forms.

The only respect in which the four wheel drive and steer truck differs from the two wheel drive is in the construction of the power transmission system and of the axle. These details are clearly shown in the illustration. The important point is to have a system of power transmission to the wheels that will make it possible to swing the wheels around for steering without interrupting the drive or reducing the efficiency of the braking functions. This is easily accomplished by mounting the wheel on a spindle of special form this member being provided with suitable bearings for supporting a spur driving pinion and also having the retaining studs necessary for carrying the braking mechanism. The special wheel carrier member incorporates a yoke of the inverted Elliot type which swings on a one piece *drop forged* axle member similar in construction to that used on practically all cars. The differential and drive gearing is secured to the non-rotating axle member. The power is transmitted from the differential gear *by means of shafts attached to universal* joints which drive the small pinions carried by the wheel spindle carrier plate. These pinions mesh with internal gears attached to the wheel. The universal joint permits the wheels to be moved *for steering and at the* same time transmits the power in a positive manner.

A special form of change speed gearing is necessary as outlined. This follows the construction of the ordinary form of positive clutch gear having the gear teeth always in mesh except that it has a supplementary shaft driven by a silent chain from which power may be

(Concluded on page 40)

Representative road tractor and some of its novel structural features, as well as typical trailers that may be drawn by a single tractor unit

Saving the Car by Careful Driving

Some of the Evils of an Excess of Caution

By H. S Whiting

ALMOST any person of average intelligence can learn to drive a car—that is he can steer it, increase its speed, slow it down, and stop it fairly well No particular gift is required to master the various controls, in fact, the large increase in motor car accidents may be due to this very ease with which a modern motor car may be made to obey its masters

But simple as may be the essentials of driving the control of a car in its most perfect form—that which will save the mechanism reduce the danger of accidents to a minimum and which will result in a smooth, steady flow of power without jolt or jar—is only to be obtained after a thorough study of the car and an experience based on a practical knowledge of its mechanism

There may be two kinds of driving that which saves the car and its mechanism and that which by its very conservatism reduces the possibilities of mishaps to a minimum The two should go hand in hand The driver who is careful of his mechanism should be equally careful of human life But such is not always the case, the driver who applies his brakes suddenly from very excess of caution may make matters far worse by causing the car to skid when careful driving would have brought it to a stop with less danger to the occupants and less wear and tear on the mechanism

It is well for every driver to remember that the gasoline engine is a high speed machine, it can develop its maximum power only at a rate of speed varying from fifteen hundred to twenty five hundred revolutions per minute and to expect it to duplicate the performance of a steam engine or electric motor is absurd and indicates gross ignorance on the part of the driver It is to overcome this inherent defect in a gasoline motor that the various speeds or gear ratios are provided By means of these, the engine speed may be maintained at a fairly constant rate for various speeds of travel of the car Obviously therefore, these speeds, or gear ratios were intended to be used whenever the load to be overcome by the rear wheels reaches a point at which the motor begins to labor But the remarkable performances of some of the modern cars on high gear have caused many amateur drivers to believe that their cars also should be capable of similar performance, with the result that there seems to be an antagonism toward gear changing that is at best a harmful superstition from the viewpoint of the motor gears rear axle and other parts subjected to the greatest strain

When the newly initiated driver operates a car, he feels that the first point to remember is the operation of the brakes so that it may be brought to a stop quickly It may seem to be a simple matter to follow the instructions of his teacher and "push with both feet, and grab the emergency brake lever" and doubtless some of the expected results will be accomplished But as in all other departments of motor car driving there is a right and a wrong way to operate the controls and to time the relative actions with each other

In bringing the car to a stop in this manner the amateur driver is not only inducing undue wear on the brake linings but is losing a most valuable ally The motor itself when allowed to slow down of its own accord as it will do when the foot is removed from the accelerator and is placed on the brake, will serve as a drag on the car that without the creation of undue friction will materially assist in bringing the vehicle to a stop Therefore, the expert driver will *not* push out his clutch until the car has been brought down to the speed at which it would be driven with the motor running in its throttled condition With the majority of cars such a speed will be in the neighborhood of five or six miles an hour Below this speed continued application of the brake without release of the clutch would stall the motor and would represent the dead line at which the driver would demonstrate his inexperience rather than his expertness

The effect of the motor when used as a brake must not be lost sight of when conditions are such that a skid is liable to occur at any moment through inexpert handling of the car The majority of skids occur when the rear wheels are locked, due to the sudden application of the brake Naturally the rear wheels lock more easily on a slippery surface when the traction is greatly reduced than is the case on a hard and dry surface, but the wheels cannot lock if the clutch is engaged and the motor is still revolving Consequently, this method of stopping the car without releasing the clutch will reduce its speed quickly, the motor in the meantime acting as a drag, but without allowing the dangerous lock to take place

But, if the use of the motor as a brake to prevent skidding is advisable on a level, it is more so when coasting down a hill the road of which is liable to be slippery A hill of moderate incline will need only the braking effect of the motor in high gear to hold the car speed down to the proper limit, without applying the brake severely If the hill is somewhat steeper, however, the motor will serve as a more effective brake if the second gear is engaged for as the power at the rear wheels is increased through the medium of a lower gear so is the resistance offered by the motor at the rear wheels increased in the same proportion. Few hills there are which, with the transmission in lowest gear will cause the car to coast faster than seven or eight miles an hour even without the application of the service or emergency brake. On long hills, the use of the motor as a brake in this manner will not only give the driver perfect control of his car, but will prevent dangerous skids on short turns and will save the linings of both emergency and service brakes.

Regardless of the astonishing performances of multi cylinder motors on high gear, the transmission will always be a part of the gasoline propelled automobile, although shifting may be reduced, it can never be eliminated The clutch is the connecting link between the motor revolving at any given speed and the transmission, which may, at times, be inert When this is the case or when the difference in speed between the motor and transmission is great, the clutch should be engaged gently But by so manipulating the throttle and the gears that the car speed and engine speed always bear the proper relation to each other shifts may be made almost without releasing the clutch, or at least so quietly and gently that the occupants of the car would scarcely know that a gear entered into its construction To drive in this manner however, the operator must bear in mind that the motor turns rapidly for slow speeds of car travel on low gear that the speed of the motor is somewhat lower for the same speed of the car in second gear, and that on high or direct drive the car travels faster for the same number of revolutions of the motor The difficulty that many motorists encounter when shifting from a high to a lower speed, is due to the fact that the momentum of the car from the previous high gear driving is so great that the rear axle is turning faster than the gear about to be meshed, which is driven by the motor A change to second gear should never be made when the car itself is traveling faster than ten or twelve miles an hour, and even under these conditions the motor should be speeded up somewhat before the change may be made without the danger of stripping the gears Similarly, a change to low gear should never be made when the car is traveling faster than four or five miles an hour And even the driver who believes that at the end of a long coast when he has disconnected the motor by throwing the transmission in neutral, he can again start it by throwing into high will find that such a practice is attended with the danger of broken gear teeth, for the transmission itself under these conditions is not revolving at sufficient speed to accommodate itself readily to the speed at which the car is coasting If a starter is employed, the motor may be run and speeded up slightly to the required point to correspond to the speed of the car at the time that the transmission is again engaged

One of the most difficult points connected with the proper operation of a car is the proper setting of the spark for different conditions of operation Some cars are provided with a set spark which permits of no variation, while others are equipped with a device which causes the time of the spark to change in accordance with the speed of the car The last named, or automatic type, however, is also provided with a control by means of which the driver may exercise some authority over the time at which the charge is ignited. The spark should be kept in its advanced position whenever the motor is driven fast, provided the rear wheels are not overloaded. As soon as the motor begins to labor, however, due to the existence of a grade or mud the spark should be retarded to the point at which the motor runs smoothest. It is especially necessary to retard the spark when climbing a hill on high gear if the momentum of the car at the beginning is not sufficient to enable the motor to maintain its speed The spark should also be retarded before accelerating the car if it is to be run slowly on high gear, for the increase in speed represents an added load on the motor, which cannot be cared for if ignition occurs too early in the stroke

It was pointed out in a preceding paragraph that the worst skids occurred when the rear wheels are locked The brakes of a modern car are so well designed that the wheels may be locked by the sudden application of both the service and emergency brakes, even though the road surface be hard and dry. On any road surface, however, if the emergency stop is necessary, it is well to apply both brakes simultaneously and then to release them slightly in order that the continued tension will not cause the wheels to slide. The temporary release of the brakes and their subsequent application will serve to keep the wheels revolving with the aid of the motor so that the car may be brought to a stop on even the slipperiest surface without great danger of skidding.

The man who can operate his car principally with the steering wheel and throttle, using the brakes and clutch only for usual conditions, such as a sudden stop, shifting gears, and the like, is the man who not only will obtain the longest service from his car, but who will have the smallest number of accidents recorded against him If the throttle is closed in time, the car may coast to a stop in about double the distance that would be required to bring it to a standstill were the brakes jammed on The fifty or a hundred feet gained by maintaining the speed of the car until necessary to apply the brake suddenly will be more than offset by the wear on tires, brake bands, gears, and other moving parts of the motor

The Current Supplement

AN interesting story in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No 2087, January 1, 1916, tells about *Building a Big Earth Dam* in California and there are several excellent illustrations showing some of the methods employed. *A Psychological Analysis of Stuttering* is an attempt to explain this annoying defect in speech, that may lead to preventative and curative methods *French Life-saving Helmets* illustrates and describes the ancient piece of armor that has been recently revived among the armies of Europe *The Transformation of Pure Iron* discusses certain physical properties of the metal in relation to the theories of allotropy *Protective Coatings for Metals* is a useful review of the various processes in use for protecting metals from oxidation. *Some Noted Zoölogical Parks* tells something of the history of the gardens of the Zoölogical Society of Philadelphia, and is accompanied by a number of attractive pictures and a plan of the grounds *The Hard wood Distillation Industry* gives an outline of the processes employed, and points out what the technical chemist has done in its development. *A New Method of Mining Coal* describes and illustrates the surface working method that has recently been adopted in several parts of the country and calls attention to the devastation that it is responsible for *Rifle Fire* illustrates how small arms are employed in attack and defense *Electric Activity in Ore Deposits* describes the complicated conditions that prevail underground, and which would have to be met in any system of electric exploration There are also articles on *The Effect of Smoke on Trees, A Method of Detecting Various Mineral and Alkaloid Poisons in Water, The Electrical Universe, The Cause and Cure of Pellagra* and other valuable matter

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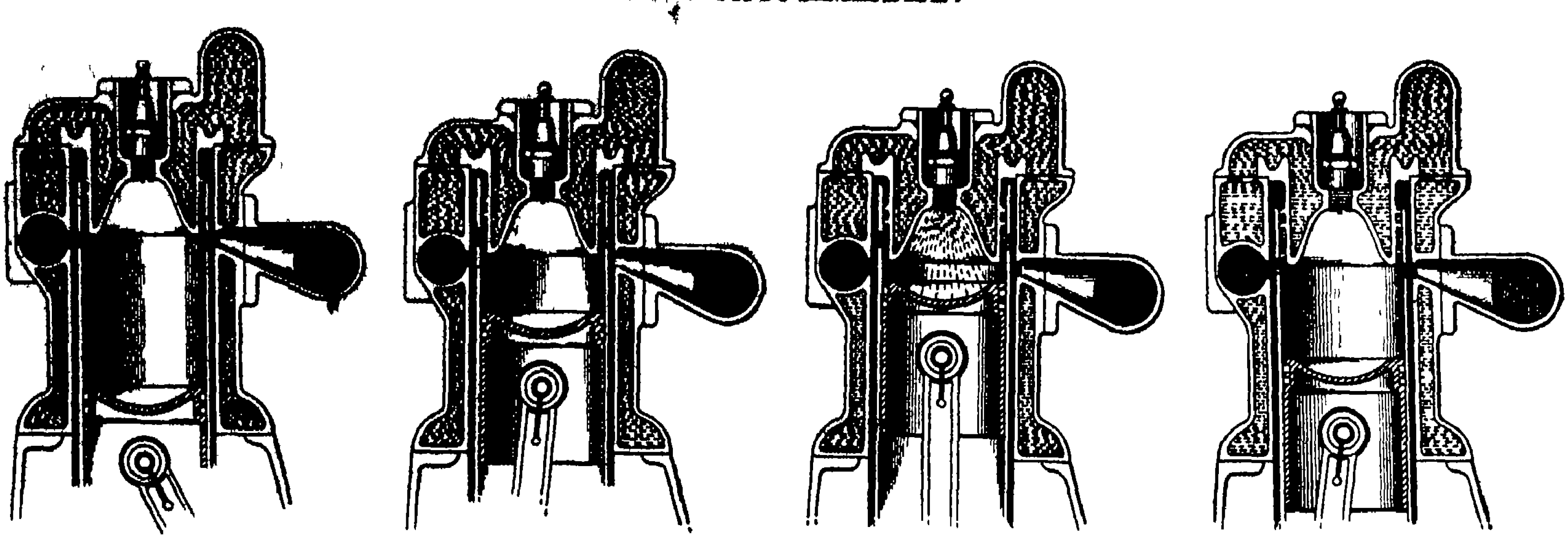
Boring for Oil in Australia

IT is probable that at an early date the oil produced from the shale deposits in the Gladstone district of Queensland will be available. The particular area on which the operations are being conducted is in the neighborhood of Lowmead, near Baffle Creek, in the Gladstone district. Bores are now being sunk for a company which has leased the land. At 172 feet in one bore a thick bed of shale was penetrated. An American company has decided to build a plant for recovering crude oil from shale.



Intake stroke—intake port open Compression stroke—all ports closed Firing stroke—all ports closed Exhaust stroke—exhaust ports open

Sectional diagrams of a sleeve-valve motor, showing position of valves during the different periods of the cycle

The Knight-Type Sleeve-Valve Motor

A Revolutionary American Invention That Has Been Widely Adopted

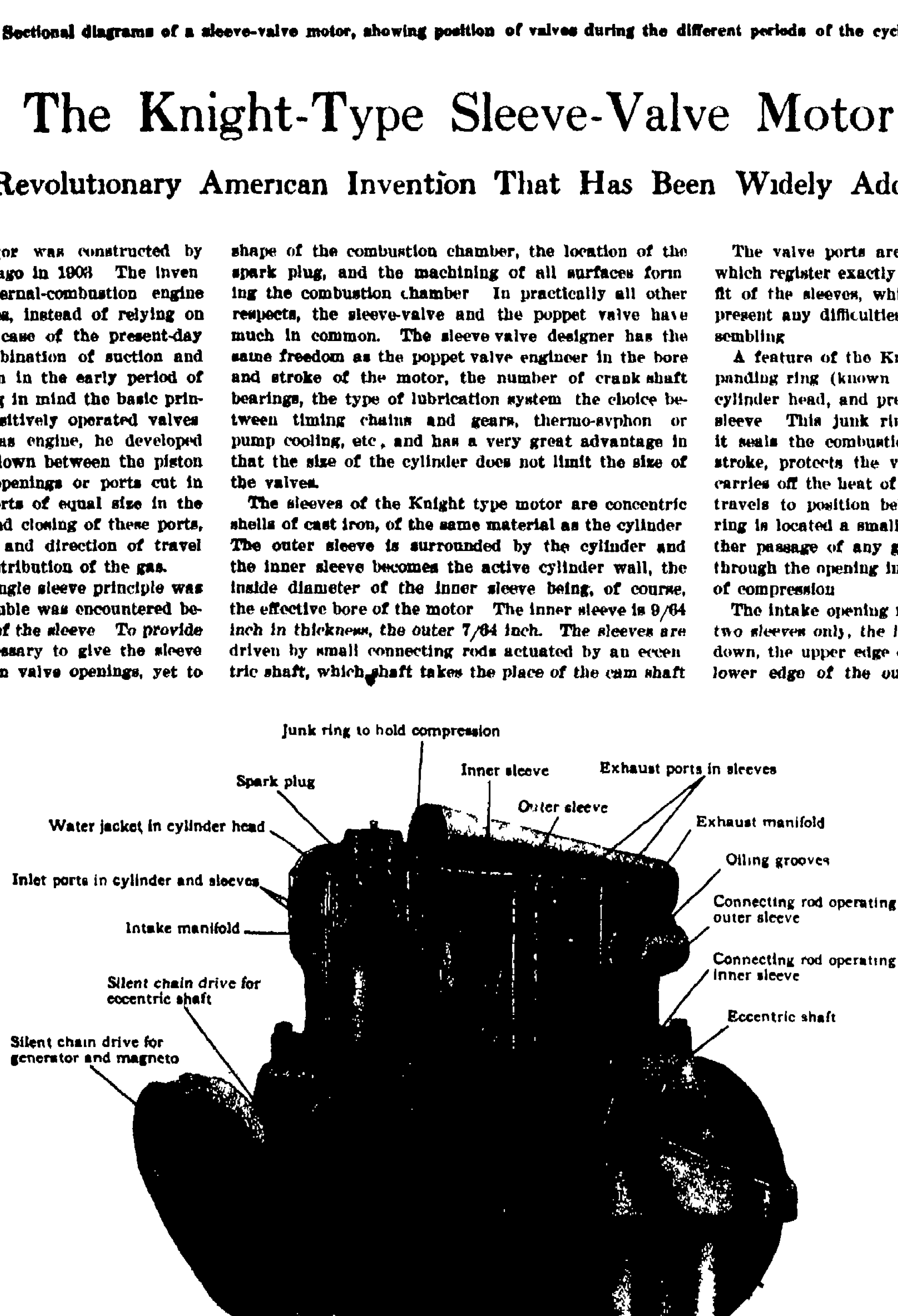
THE first sleeve-valve motor was constructed by Charles Y Knight in Chicago in 1903 The inventor sought to devise an internal-combustion engine with positively actuated valves, instead of relying on cams and springs, as in the case of the present-day poppet valve, or upon a combination of suction and poppet valves, as was common in the early period of gas engine development, having in mind the basic principle of the steam engine—positively operated valves To use this principle in a gas engine, he developed a sleeve that moved up and down between the piston and cylinder wall, and had openings or ports cut in the sleeve registering with ports of equal size in the cylinder wall. The opening and closing of these ports, with relation to the position and direction of travel of the piston controlled the distribution of the gas.

This first motor using the single sleeve principle was fairly successful, but some trouble was encountered because of the uneven operation of the sleeve To provide the proper timing it was necessary to give the sleeve extremely rapid travel between valve openings, yet to greatly reduce the speed when the ports were in register Because of the difficulty in providing sufficiently large openings it was found advisable to use an auxiliary exhaust port in the lower part of the sleeve, the piston uncovering this port while traveling down on the explosion stroke. After many attempts to overcome the difficulties presented by the single sleeve design, Knight conceived the idea of using two sleeves, and in 1904-1905 produced the engine much in its present form. During the two succeeding years he further developed his engine, and endeavored to interest American manufacturers In this he was unsuccessful, but during 1905-1906 produced 150 complete cars, which by their successful operation vindicated the sleeve-valve principle.

American manufacturers, however, were not impressed, and in 1907 Knight went abroad upon the invitation of the Daimler Company, Ltd., Coventry, England, which company the following year placed the Knight car upon the market, utilizing Knight's principles and ideas with but minor changes. The action of the Daimler Company was followed shortly by the adoption of Knight's invention by a number of European manufacturers.

The sleeve-valve motor differs from the ordinary automobile engine in four distinct ways, the valving, the shape of the combustion chamber, the location of the spark plug, and the machining of all surfaces forming the combustion chamber In practically all other respects, the sleeve-valve and the poppet valve have much in common. The sleeve valve designer has the same freedom as the poppet valve engineer in the bore and stroke of the motor, the number of crank shaft bearings, the type of lubrication system the choice between timing chains and gears, thermo-syphon or pump cooling, etc, and has a very great advantage in that the size of the cylinder does not limit the size of the valves.

The sleeves of the Knight type motor are concentric shells of cast iron, of the same material as the cylinder The outer sleeve is surrounded by the cylinder and the inner sleeve becomes the active cylinder wall, the inside diameter of the inner sleeve being, of course, the effective bore of the motor The inner sleeve is 9/64 inch in thickness, the outer 7/64 inch. The sleeves are driven by small connecting rods actuated by an eccentric shaft, which shaft takes the place of the cam shaft in the ordinary L-head design of poppet valve motor The eccentric shaft runs at one half crank shaft speed, and the travel of the sleeves is less than one ninth that of the piston. In the case of an engine having a stroke of $4\frac{1}{2}$ inches, the sleeves travel 29/32 inch to each up-and-down stroke of the piston, which, of course is 9 inches for this engine.



Sectional view of the Knight-type sleeve-valve engine

The valve ports are the same size in both sleeves, which register exactly at the time of full opening The fit of the sleeves, while snug is not tight enough to present any difficulties either in manufacturing or assembling

A feature of the Knight type motor is the wide expanding ring (known as the junk ring) located in the cylinder head, and pressing outward against the inner sleeve This junk ring plays an important part, for it seals the combustion chamber on the compression stroke, protects the valves at time of explosion, and carries off the heat of the inner sleeve when the latter travels to position behind the ring Above the junk ring is located a smaller ring, intended to prevent further passage of any gas which may have been forced through the opening in the junk ring during the period of compression

The intake opening results from the operation of the two sleeves only, the inner traveling up, and the outer down, the upper edge of the inner sleeve port and the lower edge of the outer sleeve port traveling away from each other, and calling into play the full opening of the port, the valve opening at $6\frac{1}{2}$ deg. after top center, and closing 45 deg after lower center The intake port when closing however depends upon the action of the inner sleeve in its relation to the junk ring, the outer sleeve taking no part in closing the valve, as it travels behind the inner sleeve The travel of the lower edge of the port in the inner sleeve to its position behind the junk ring closes the port, and the pressure of the ring against the inner sleeve seals the combustion chamber From this it will be noted that the sleeves, in so far as their relations with each other are concerned have nothing whatsoever to do with retaining the compression. The junk ring seals the chamber above just as the piston rings seal it below (the inner sleeve being also the active cylinder wall) and the outer sleeve serving merely as an auxiliary in the proper functioning of the valves. In this connection it is interesting to observe the assistance which the inner sleeve gives to the piston on the two strokes or cycles during which the piston is called upon to perform its greatest work—namely compression and explosion During compression when the piston is laboring to compress the gas, and hence exert-

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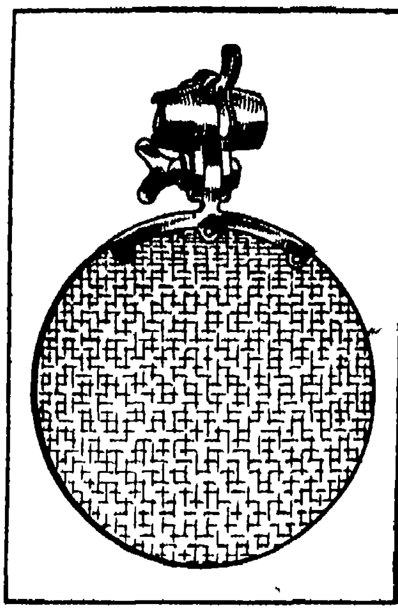
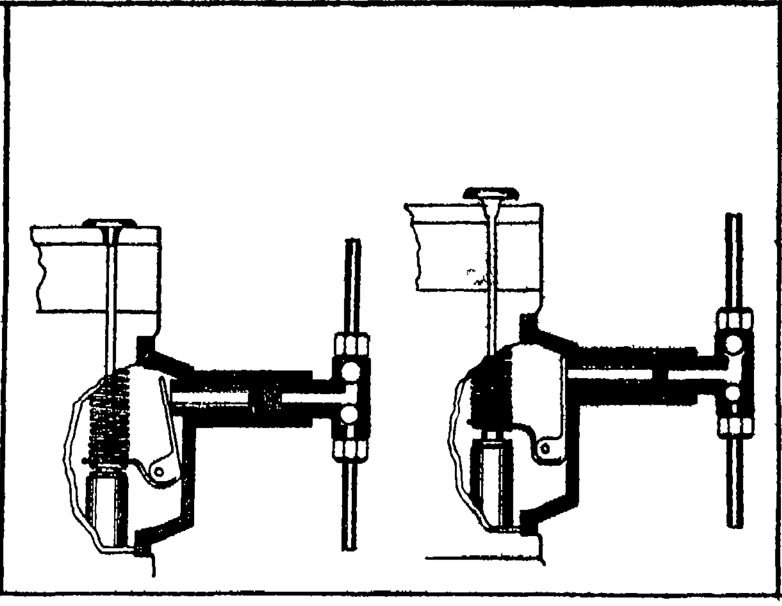
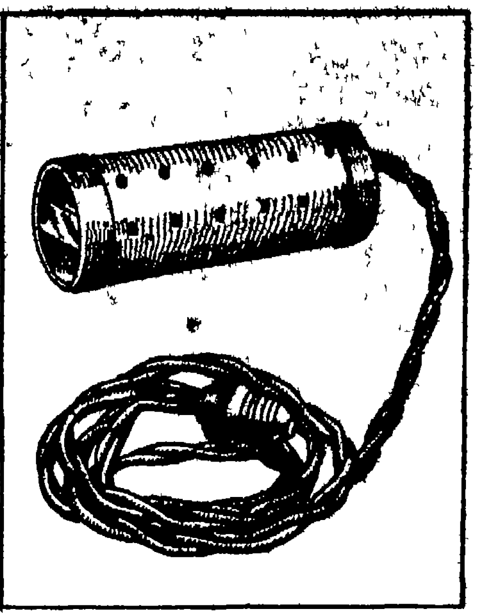


Adjustable color screen for protection against headlight glare



Sectional views of an oil pump, driven by the valve mechanism of an engine, showing the parts at the moments of intake and pumping the oil



An electric heater that is designed for warming the power plant of an automobile

New Accessories for the Automobile

Offerings for 1916 as Numerous and Diversified as Those of Previous Years

AUTOMOBILE accessories for the 1916 season may be said to be as numerous and ingenious as those of any previous year While the greater part of the offerings are in the form of improvements over existing articles, not a few may be considered distinct novelties

While practically all the large and many of the small cities have ordinances forbidding the use of blinding headlights, in many parts of the country, along open roads there is no prohibition, and consequently night driving is often made dangerous by the headlights of approaching cars dazzling the driver To prevent this, a goggle manufacturer is making a goggle the upper half of which is colored, so that when bright lights approach the driver has but to tip his head slightly to bring the colored portion in the line of vision The lenses are of glass, in one piece—not two pieces cemented The same company also makes a goggle of a transparent composition colored above The composition is like celluloid, but will not burn

Another form of protection against the blinding headlight uses the same principle namely, that of a color screen This accessory, however, is put on the windshield and consists of a circular amber colored disk of glass that is clamped to the top of the wind shield in front of the driver When a car approaches at night, it is only necessary for the driver to bring the disk in position between his eyes and the coming headlights. The device is easily attached to any wind shield by means of a screw clamp

Use of one of the valves of the automobile motor for driving an oil pump is made by a western company The device is designed for a car that does not have a force feed system of oiling nor any very convenient way of driving an oil pump It is attached to the side of the motor in place of one of the valve cover plates and has a small pump piston The piston is operated by a levered rocker arm, which in turn is operated by an arm attached to the valve stem As the valve goes up and down, the rocker arm drives the oil pump piston in and out, circulating the oil

It is fully possible to heat a closed automobile and even a touring car when the rain curtains are down from the exhaust of the motor One of the large parts manufacturing companies is now introducing an exhaust heater which has proved successful in use this winter The heater simply consists of a copper tube radiator installed in the floor of the tonneau, through which part of the exhaust gases pass A valve is provided to regulate the flow of the gases. There is also a vertical radiator to place against the heel board of the seat in the case of a coupe or runabout.

Another new device is one for keeping the motor warm It operates by electricity and consists of a small metal cylinder containing an electric heating element It is simply placed under the hood of the car and the current turned on The heater is $2\frac{1}{2}$ inches in diameter and 6 inches long, and consumes 100 watts. It may be attached to any lamp socket. At ten cents per kilowatt hour, it costs one cent per hour to operate, and on lower rates a corresponding lower cost.

Air may also be used to fill the grease cups and transmission and differential cases with grease, and among the new accessories two different devices employing this agent are offered. One is a conventional grease gun in shape and construction, but instead of having a rod and handle connected to its piston, it has an air chamber When pressure is applied by means of air, the grease is forced out without any effort on the part of the operator The rapidity of flow depends on the viscosity of the grease and the pressure of air, but it is stated that comparatively little pressure is necessary

When a man drives a car, it is virtually impossible for him to take out his watch to ascertain the time. Even when there is a clock on the dash it is not always easily seen, especially at dusk or in the night. There is now on the market a watch that is screwed directly in the center of the steering wheel, where it may be seen at a glance. To the back of its case is fastened a nut, similar to the one on top of the steering post, and the new nut bearing the watch is simply substituted for the old.

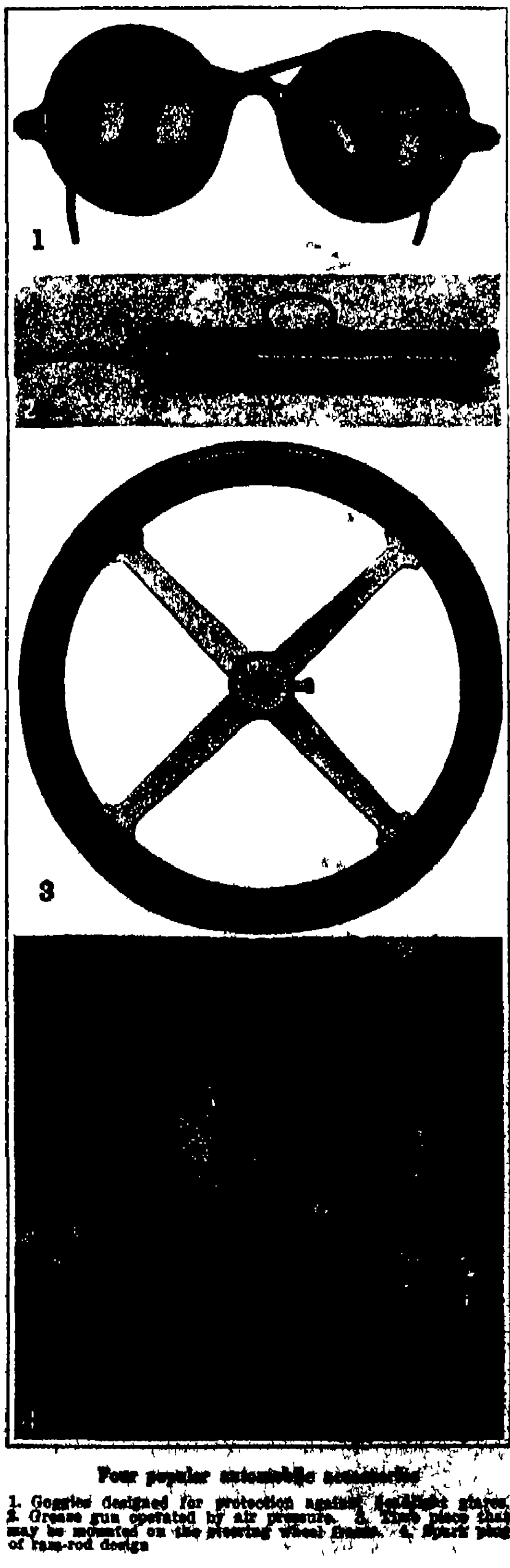
Spark plugs must have their points cleaned of carbon occasionally, and often it is necessary to prime the motor These two operations are combined in one in a new spark plug of unusual construction It has its central electrode in one piece and removable from the plug shell by simply giving it a short twist to open a lock joint The electrode may then be removed, just like a ramrod from a gun There is then presented a clear passage into the motor cylinder for priming with gasoline, and the central electrode may be easily cleaned in the hand To clean the points on the plug shell within the cylinder, an ordinary pipe stem cleaner is moistened in gasoline and run through the shell. The plug greatly facilitates cleaning and priming.

Now that air pumps driven by the car motor have placed at the disposal of the motorist a plentiful supply of air at high pressure air is beginning to be used for purposes other than the inflating of tires In addition to furnishing a means of cleaning the upholstery, air may now be used to jack up the car An air jack made for this purpose will lift the heaviest car with only 80 pounds pressure to the square inch from the air pump. Even when a power pump is not on the car, a hand pump may be used. It is stated that seven strokes of the usual hand pump will lift the average car The jack weighs six pounds and is only four inches in diameter

Because it is a nuisance to carry into the restaurant or theater or office or home all the coats, robes, suit cases and other articles that are carried in an automobile, many motorists leave them in the car. This gives an opportunity that the sneak thief is not slow to take advantage of In order to prevent his making off with such things, there is a robe lock that clasps about the robe rail and anything that may be on it. It has jaws that grip tightly and that lock in any position. An easily-operated combination dial releases the jaws.

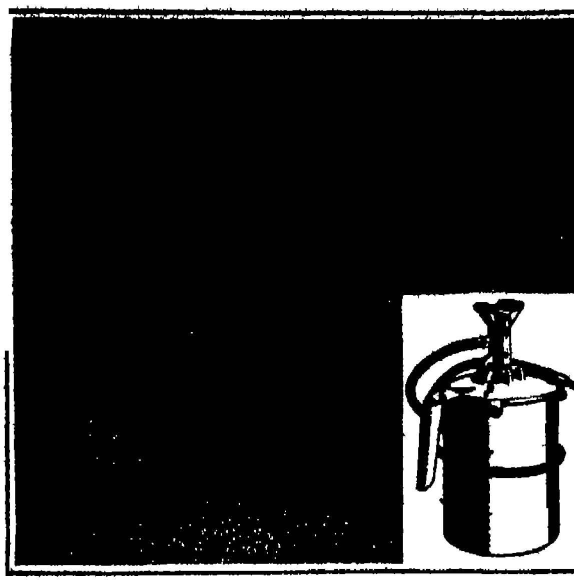
Complete protection for all but the head, shoulders and arms of the driver of the open car is afforded by a new robe that covers the top of the driving compartment from the top of the dash to the back of the seat. It thus allows full freedom of movement for the driver's feet and also an air space for the heat from the motor in front to warm through the dash. The robe is provided with straps and fasteners by which it is held tightly to the dash and the side of the body.

Many a man's wife drives his car just as well as he does, but with much inconvenience in reaching the pedals which may be just right for the husband, but

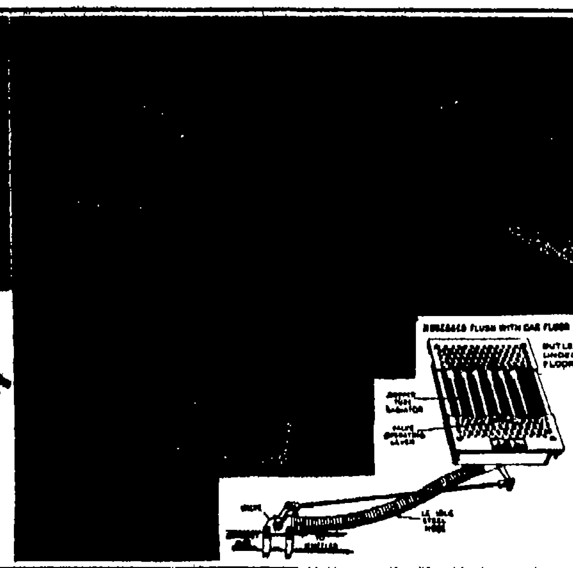


Four popular automobile accessories

1. Goggles designed for protection against headlight glare. 2. Grease gun operated by air pressure. 3. Time piece that may be mounted on the steering wheel frame. 4. Spark plug of ram-rod design



Automobile jack operating on 80 pounds air pressure supplied by the car's power pump



Heater utilizing the exhaust gases of the power plant, installed in the tonneau floor

Combination lock that may be used for safeguarding robes, coats, luggage and other articles

almost out of reach for the wife. Such couples are offered an ingenious double pedal attachment in which a second pedal may be placed above the original pedal at any desired height. The device is simply clamped to the original pedal without any drilling of holes. Both pedals are left free for use by the two persons. When the wife drives, she takes the upper and higher pedal pad, and when her husband is at the wheel, he uses the original pedal.

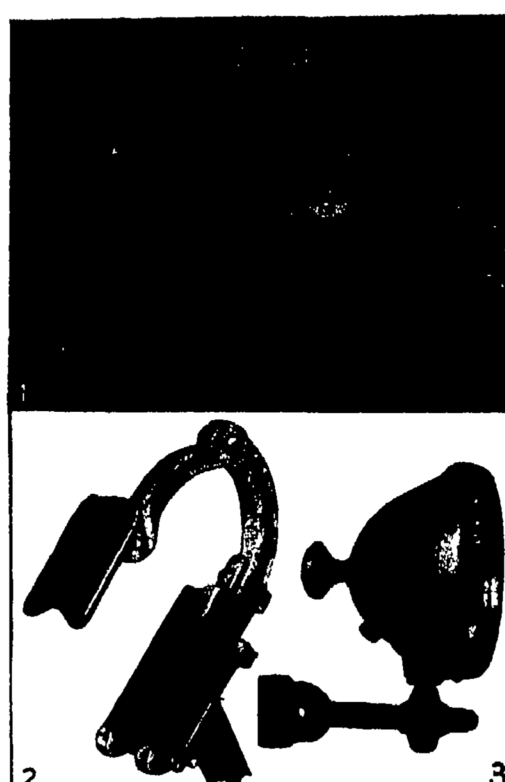
Due to the almost universal condemnation of blinding automobile headlights and the consequent dimming of them they have become almost useless as long distance touring aids at night. The dimmed headlight will not throw a sufficiently strong beam. This coupled with the need for some movable searchlight has brought forth the hand searchlight, which almost disappeared when electric headlights became powerful. The present searchlights however, are not like the old clumsy ones of a few years ago. They are small high power lamps, utilizing nitrogen filled bulbs of high candle power but low current consumption. It is claimed for one of them that it gives such a strong hot ray that is so well focused that a cigarette may be lit in it.

Many motorists would install motor-driven air pumps on their cars were it not for the expense of applying them to the motor due to the difficulty of finding a suitable base on which to mount them and of providing a practical means of driving them. A most simple motor-driven air pump has just appeared. It takes the place formerly occupied by the starting crank which is now absent in most cars, due to the use of self-starters. The pump is simply inserted in the crank hole until a clutch on its driving shaft meets the end of the motor crankshaft. It is then tightened in place by means of an expanding sleeve. The pump will develop over 100 pounds pressure and may be had in models to fit any car.

A novel device in which air is used to deliver grease takes the form of a bucket in which air pressure is created by screwing down a handle attached to a threaded rod bearing a piston. The bucket is most versatile, as it has two compartments in which two different kinds of grease may be carried. In addition to discharging the grease contained within itself it may be used to suck out the used and dirty grease from a differential or transmission case and deliver it into a third receptacle. The bucket is also self measuring and will dispense grease by pounds and heavy lubricating oil by quarts.

It is always a problem to dispose of the sixth passenger in a five-passenger car and the ride is never a matter of comfort for the sixth person and his or her companions unless an extra seat is carried. One of the newest seats is unusual in that instead of being placed loosely on the tonneau floor, it is hung on the side of the body or on the door. This gives it a firm support and prevents it from dancing about as the car bounces over uneven roads. The seat is strongly made and has its frame well padded where it fits over the door, to prevent marring the varnish or leather. When not in use it folds into a small space and can be put away.

The original mechanical automobile starter worked by air pressure yet it is startling to hear that a leading company in the automobile industry is returning to air pressure as a starting agent at this time when electric starters reign supreme. The new starter, which is sold separately as an accessory, is distinguished in that it simulates hand cranking in its application of power to the motor crankshaft. Instead of turning the motor over continuously until it starts, it spins it only a few revolutions at a time. This is due to the use of a so-called "bat wing" piston which travels around in a ring shaped cylinder from one side of a stationary head to the other. An air pump and tank are parts of the system.



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Seven of the most novel accessory offerings for the 1916 season

1. [illegible] blanket for the driver of an open car. 2. Auxiliary pedal for facilitating the driving of cars by women. 3. Adjustable electric searchlight. 4 Power-driven tire pump that occupies the place of the discarded crank handle. 5. Bucket pump for oiling or removing grease and oil in differential cases. 6. Folding seat that may be attached to the automobile body without tools. 7. Working parts of compressed air engine starter.

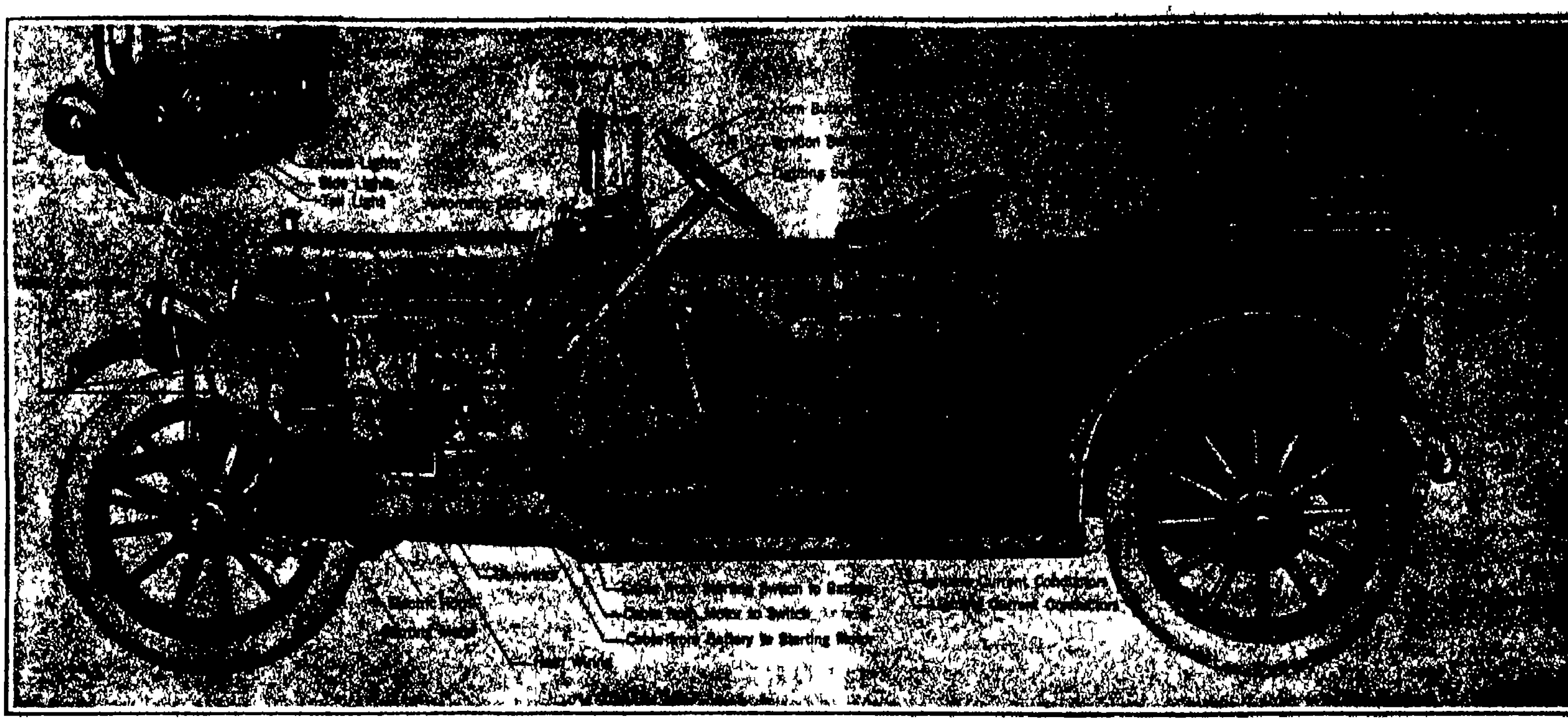
New Dry Dock for Rotterdam

AN automatic dry dock for a ship building concern at Rotterdam has been recently completed and transported to its destination. As the dock was too bulky to pass the locks of the North Sea Canal, it has been built on land at Schellingwoude, outside the Orange Locks and after completion towed to Rotterdam by way of the Zuider Zee past Helder.

The dock consists of three sections, coupled together and admitting of being uncoupled. Its end sections are pointed. It has eight water tight cross bulkheads three water tight bulkheads lengthwise and four water tight coupling bulkheads constituting the two coupling chambers. The dock will be provided with three main pumps of 90 horse power each permitting of joint or separate operation. Besides these there will be three wash pumps each provided with a motor of 35 horse-power. All pumps are of the centrifugal type with vertical axle. The pumps are to be worked from a service building on the dock of the air compartment of the middle section of the dock. Here, also, are the main switchboard, the water indicator and the air compressor with its motor. The new dock has a lifting capacity of 12,500 to 13,000 tons and can accommodate ships measuring up to 13,000 registered tons.

Content of Gasoline Vapor in Air Determined

TWO methods of determining the content of gasoline vapor in air have been the subject of experiments and a report by the United States Bureau of Mines. In one the mixture is introduced into an exhausted glass vessel, is cooled at the temperature of liquid air, the air is removed, and, finally the partial pressure of the gasoline vapor is measured by means of a manometer attached to the liquefaction bulb. The second method consists in burning the gasoline vapor in oxygen and from the contraction and carbon dioxide produced calculating the percentage of gasoline vapor



Phantom view of an automobile, showing typical two-unit starting, lighting and ignition system to indicate the relation of the various components to each other and to the car mechanism, as well as outlining the various circuits

Electric Starting and Lighting Systems

Their Proper Care and Maintenance by the Motor Car Owner or Driver

BEFORE considering the subject of starting and lighting system maintenance, it may be well to outline briefly the characterization of the main classifications into which the legion of such systems may be grouped. Though many different forms and combinations of devices have been contrived to secure the automatic motor starting feature practically all of the systems operate on the same basic principles. If the features of the leading systems are described it should not be difficult for the autoist or mechanic to familiarize himself with the arrangement of any system that differs only in points of minor detail.

Essentials of an Electric Starting and Lighting System

The standard equipment must include three main components—namely, the current producer which is a small dynamo driven by the engine, and which is used to generate electricity for charging the storage battery, a specially constructed secondary battery to act as a reservoir for the current generated by the dynamo, and a starting motor which may be mechanically connected with the engine and electrically coupled to the storage battery when it is desired to turn the engine crankshaft through the initial phases of its cycle of operations.

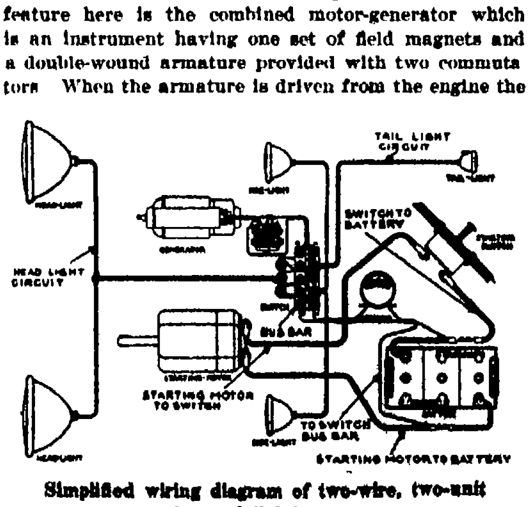
It is possible to combine the current producing and engine starting functions in one instrument. This may be a single machine, having only one set of windings on the armature and one commutator, or it may be a combination instrument having a double wound armature and two commutators. Either of these are called "one unit" machines. If the starting motor is one device and the generator a distinct appliance, the system is called a "two unit" type. Some forms have been devised in which the generator is mounted in the same casing as the starting motor, and these have been erroneously called "one unit" machines. It will be evident that in any system where the starting motor and current generator are electrically distinct, we have a "two unit" system.

In addition to the three main components just named various accessories are necessary to control or distribute the electric current. These include switches, current measuring meters, connectors and wiring, protective circuit breakers or fuse boxes, automatic voltage regulators, cut-out relays, and the current consuming devices.

The electrical starting and lighting systems that have received general application usually operate on 6-volt current, although some of the one unit systems require 12- or 24-volt storage batteries. The 6-volt system is generally favored, because the lamps designed to operate on that voltage use more substantial filaments than those of higher voltage and are not so fragile and subject to breakage from the inevitable vibration that is present in an automobile. Another advantage of a 6-volt system is that it is much easier to obtain replacements if any of the units become defective through wear or accident.

The One Unit Type of Starting and Lighting System

In referring to a system as a "one unit" system of lighting, starting and ignition, one means that all of these functions are incorporated in one device as shown in one of the accompanying illustrations. The feature here is the combined motor-generator which is an instrument having one set of field magnets and a double-wound armature provided with two commutators. When the armature is driven from the engine the device generates electric current which flows to the storage battery. An overrunning clutch is interposed between the driving shaft and the armature at both engine and starting ends. If it is desired to start the engine, an intermediate reduction gear is moved into engagement with a large gear cut on the flywheel periphery and simultaneously a brush is pressed on the motor commutator which permits the storage battery current to flow through the machine and make it an electric motor. In this case the armature revolves at a high rate of speed and the forward overrunning clutch breaks the driving connection that normally exists between the pump shaft and the armature. Similarly, as soon as the engine starts, an overrunning clutch mounted in the intermediate reduction gearing releases the drive and permits the clutch at the front end of the machine to become operative and drive the armature at the slower ratio of speed necessary to generate current for charging the storage battery. As will be apparent this system is simpler, both mechanically and electrically than the "two-unit" system, which is also illustrated. The latter is depicted in such a way that the relation the various parts bear to each other and the automobile chassis parts can be easily recognized.



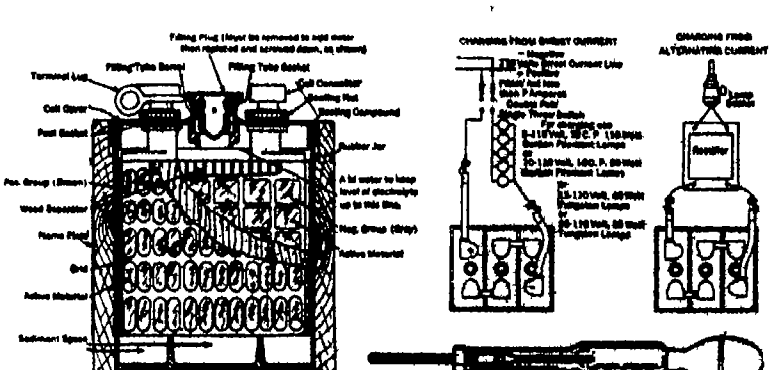
Simplified wiring diagram of two-wire, two-unit starting and lighting system

Practically all the time that the automobile power plant is in action, current is being produced by the generator, and delivered either to the storage battery or to the various current consuming units, such as the ignition system, electric horn and lamps. The surplus current is accumulated in the storage battery and is kept in reserve for starting the engine or lighting the car when the power plant is not in operation or for ignition and lighting when the car is being operated at such low speeds that the cutout of current regulating devices do not permit the current from the generator to flow to the storage battery or to the current consuming units.

Storage Batteries for Automobile Use

The storage batteries devised for engine starting purposes or for car lighting systems must be of special design and large capacity in order to withstand the high discharge rate necessary to operate the starting motor and at the same time capable of rendering efficient service under the severe vibratory stresses and unusual operating conditions incidental to automobiles. It is important to install the storage battery in an accessible location in order that it may receive the attention necessary. The best practice is to set the storage battery in a substantial carrying case under the front seat, on the running board or under the tonneau floor boards.

Practically all cells are provided with an expansion chamber, which receives the gas evolved during the charging or discharging process, and also a combined gas vent and filling plug to prevent the accumulation of gas pressure. This filling plug is removable to permit inspection of the battery interior and to make possible the addition of electrolyte if the cells are emptied or distilled water to replace the liquid lost by evaporation. As will be noted in the illustration, the hard rubber cell jars are carried in a substantial



Sectional view of a heavy duty storage battery for automobile starting and lighting service, the method of charging such a battery of six-volt rating, and a hydrometer syringe

wooden case and after the cell covers have been put in place the entire top of the wood box is sealed with a compound of pitch and other ingredients which not only acts as an electrical insulator, but which also prevents escape of gas or the splashing of liquid, as well as forming an intimate bond between the cells that prevents movement of these relative to each other or the carrying case.

The Electric Starting Motor

The starting motor which replaces the ordinary hand crank is usually a series-wound machine of simple design. The construction of the starting motor is practically the same as that of a dynamo except for the size of the windings which are designed for the passage of the large amperage current necessary to produce proper starting torque. In other respects the starting motor and dynamo operate on practically the same principles except that one instrument is a reversal of the other. In order to obtain a high power output from a small low voltage starting motor it is necessary to revolve the armature at a rate of speed ranging from 2,000 to 2,500 r.p.m. As it is not necessary or, in fact, possible to turn the engine crankshaft faster than 150 to 200 r.p.m. when starting the engine, a speed reduction gearing is introduced between the starting motor and the engine crankshaft. The reduction is usually about 20 to 1, which means that the starting motor armature will revolve 20 times to produce one revolution of the engine crankshaft. The wiring to the starting motor is simple but is of heavy cable because from 60 to 150 amperes current must pass through the motor windings. The starting switch is always interposed in the motor battery circuit.

Automatic Control Devices in Self-Starter Circuits

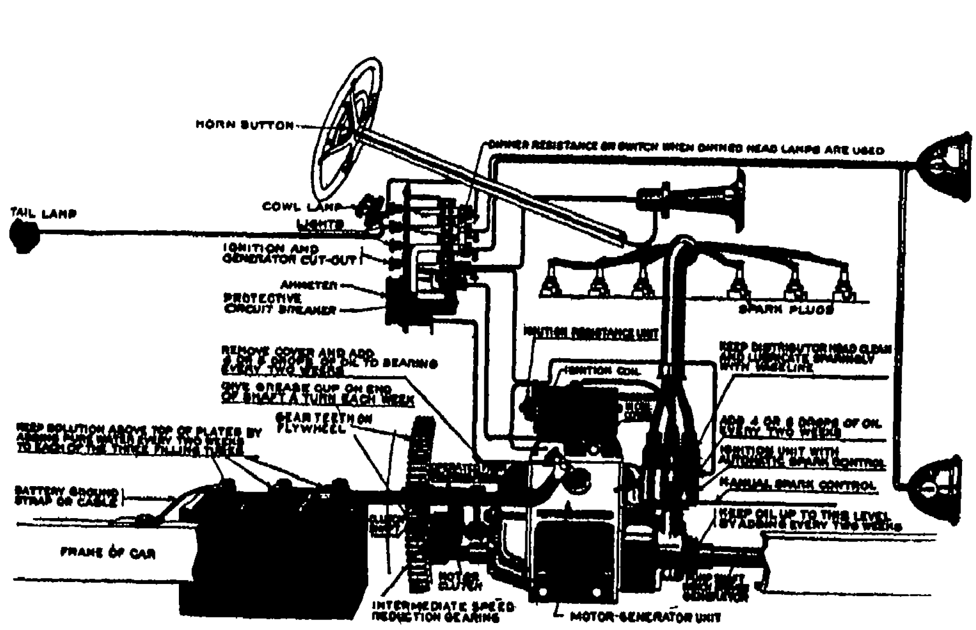
It is evident that electric starting and lighting systems would not be practical for the use of the average motorist unless they incorporated automatic control appliances. A number of mechanical and electrical controls are needed to attain this end. These include the circuit breaker, a governor or voltage regulator, which may be either mechanical or electrical, and the operating switches. Circuit breakers are of two forms, viz., those termed protective circuit breakers are safety appliances that perform the same function as a fuse, while the automatic cutout relay, which is sometimes called a circuit breaker, is a device having a different function. The automatic cut out is used to keep the current from flowing out of the storage battery under those conditions of operation during which the battery current is stronger than that delivered from the generator. If no circuit breaker is provided, when the engine speed is reduced to a point where the generator voltage is less than that of the battery, the current flows through the generator windings and is wasted. The cutout circuit breaker is a very simple device and is operated by an electro magnet. In some cases it is combined with the generator or mounted thereon, although it may be placed in any convenient part of the car. The protective circuit breaker usually forms part of the combination switch in the single unit systems with which it is used.

The voltage regulators or their mechanical equivalents are required to prevent an excessive current output from the generator when the power plant is running at extremely high speed. Two types are used, the mechanical form being a centrifugal governor mechanism, though the electrical method may operate on the third brush excitation principle which provides inherent regulation, or by a resistance-relay system which reduces the strength of the field magnet by interposing resistance in series with the field coil. The mechanical type is usually a friction driven mechanism attached to the driving end of the generator and having a clutch to transmit power to the generator armature shaft. The combination of the centrifugal governor and clutch automatically limits the speed of the dynamo armature to a predetermined number of revolutions. This results in the current generated being held to a required amount independently of the speed of the engine or car. The governor minimizes overheating the generator or overcharging the storage battery at high engine speed. The electrical system of governing does not materially influence the generator speed but controls the current output by means of armature reaction, a bucking coil or resistance or a reversed series field winding. Regardless of the system of governing used, these usually permit a maximum generator output of from 10 to 12 amperes, though the normal charging current is less than this.

In practically all systems an ampere meter is mounted in connection with the operating switch or at some convenient point on the dash where it may be readily inspected by the operator. This is joined to the storage battery in such a way that it indicates at all times the amount of current being delivered to the battery or the amount drawn from that source. If the indicating needle of the ampere meter points to the left of the zero on the scale it means that current is being furnished to the consuming units and that the battery is discharging.

Another important element is the lighting switch which is always mounted at some point within convenient reach of the car driver. A common location is on an instrument board in connection with the other registering instruments.

Two sides of an automobile power plant, showing how the ignition, current-generating and engine-starting units are installed, using the unit system



Complete wiring diagram of a typical "one-unit," grounded-return or one-wire starting, lighting and ignition system that has received wide application

The Care of the Storage Battery

The storage battery is the part of the lighting and starting system that requires the most attention and unless this receives periodical inspection it is apt to be seriously damaged. The first point to observe is cleanliness of the battery and interior of the battery compartment, which must always be clean and dry. All small articles, especially of metal, must be kept away from the battery. All terminals and connections should be kept coated with vaseline. If any electrolyte has spilled out of the battery, it should be wiped off with waste wet with ammonia, and the bottom of the battery compartment covered with a small amount of slaked lime to neutralize the acid. It is essential that pure water be added to all cells regularly and at sufficiently frequent intervals to maintain the solution at the proper height above the plates. This height varies in different batteries, but the important point to observe is that the plates are always covered with solution. The solution should never get below the top of the plates.

The vent plugs are removed to add the distilled water, which may be introduced with a syringe, and should always be screwed down tight after filling. In warm weather the battery cells should receive distilled water every week and once every two weeks in cold weather. Never add acid to the solution and do not use any water known to contain even small quantities of salts or mineral matter of any kind. If distilled water is not available melted artificial ice or fresh, clean rain water may be used. The water should be added at regular intervals as recommended even though the battery may apparently function correctly without it.

The best way to determine the condition of the battery is to test the specific gravity of the solution in each cell with a hydrometer. A convenient time to do this is when water is added, but the reading should always be taken before any water is introduced into the cells. Specific gravity readings are made with a hydrometer syringe of the type shown. To take a reading with this instrument, insert the end of the rubber tube in the cell, being sure to place it below the level of the electrolyte. Squeeze the bulb, then slowly release it to draw up enough electrolyte from the cell to float the hydrometer. The reading is taken from the graduated stem of the hydrometer at the point where it emerges from the solution.

The gravity reading is expressed in "points," the difference between 1.275 and 1.300 being 25 points. After testing, the electrolyte must always be returned to cell from which it was taken. When all cells are in good order the gravity should test within 25 points of being the same in all cells. A reading above 1.200 indicates the battery is more than half charged. The nearly complete charge is indicated by a reading of about 1.275. A reading below 1.150 indicates that the battery is completely discharged. The complete charge is indicated by a reading anywhere between 1.275 and 1.300.

In charging from an outside source, which is often necessary if the car is operated extensively at night and very little in the daytime or if the engine starts hard, there are two possible methods. Only direct current can be passed through the battery, although, of course, the current flowing through the mains may be either direct or alternating. The most convenient method of charging when a direct current is available is to use a lamp bank resistance as indicated in one of the accompanying sketches. This limits the current to the proper charging rate in amperes depending upon the number of lamps used. The ordinary 6-volt battery will be properly charged if five 110-volt, 32-candle power carbon filament lamps or ten 16-candle power carbon filament lamps are used. It will take thirteen 40-watt tungsten lamps to accomplish the same results.

Always connect the positive terminal of the battery, which is that marked "P" or indicated with a plus sign to the positive charging wire and the negative terminal to the negative charging wire. If connections are reversed serious injury to the plates will result. The charging wires may be tested for positive or negative polarity by trial with a voltmeter or by dipping the ends in a glass of water containing a few drops of electrolyte. This will indicate the negative wire by the bubbles formed upon it.

Any storage battery which is to stand idle should first be fully charged. A battery not in active service may be kept in condition by giving a freshening charge at least once a month, but it should also be given a thorough charge before it is replaced in service.

In order to avoid freezing the battery it should always be kept in a fully charged condition. A discharged battery will freeze at 20 degrees above zero, while one

(Concluded on page 44)

The "Blind Turn"

Its Dangers and Various Methods of Solution

By Chas. F. Barrett

NO railroad president would sanction the passage of one of his trains from the "down" to the "up" track without first making sure that there was no train approaching in the section of track to be traversed. Yet that same railroad president along with many other ordinarily careful people is daily taking precisely the same chance in his automobile on "blind turns" which he would not permit his train crew to make under penalty of discharge.

What is the greatest menace of the "blind turn"? Not as most people would believe the danger of a simple head-on collision between two cars approaching from opposite directions due to carelessness in not keeping far enough to the right. Such accidents are all too prevalent but by far the most common trouble is due to the mixed traffic of slow and fast moving vehicles. Fig. 1 illustrates the usual conditions occurring on "blind turns" which are likely to result disastrously. In this diagram it will be noted that a wagon is slowly passing around the turn while an automobile is approaching from either end. If the turn is long and the automobile driver going in the same direction as the wagon is in a hurry as is usually the case the temptation of the latter to swing over to the left and pass the wagon on the curve becomes very great. This maneuver throws him directly in the path of the other automobile approaching and makes a collision most imminent.

It is this sort of risk that the railroad president allows his chauffeur to take almost daily with many a hair-breadth escape. It takes more patience than the average American has to stay patiently behind a slow plodding team until safely around the curve. Few can hold themselves back from taking a chance. And the tragic part of the proposition is that the poor fellow who gets bumped into may be the most careful pains taking sort of a driver and although exercising the utmost precautions himself in keeping far to the right running slowly etc. he may be more seriously wrecked than the reckless driver. Moreover the team is very likely to get mixed up in the crash also in the strenuous efforts of the automobile drivers to avoid each other when a collision seems imminent.

This traffic condition and the resulting accidents are a daily occurrence particularly in the eastern part of the country where heavy automobile traffic and frequent "blind turns" are common. With the rapid increase of automobile traffic on the trunk lines it would seem that some solution of these menaces must be found without delay.

In considering the possible remedies for partially or entirely overcoming the dangers of this condition we find two general methods of attacking the problem: one by changes in the character, location curvature banks etc. of the road itself and the other by the use of automatic signaling devices or other independent features for the traveler's protection.

On a careful inspection of actual conditions as they are found in most localities it is surprising to note how many of these death traps could be shorn of much of their dangerous character by resorting to simple methods under the first classification. Take as an example the high, wooded bank which forms the most usual "blind turn" condition. In many cases of the latter the simple expedient of cutting off the brush and keeping it clear will make the turn over 50 per cent safer if not entirely so. Sometimes removing a little of the bank at the height of the line of vision and just at the middle of the turn will accomplish wonders in this regard. Traffic conditions have now arrived at a point where the failure to adopt all such comparatively inexpensive means of making the roads safer will be held as inexcusable. In some cases where rebuilding of a roadway is being undertaken it is possible to avoid bad turns by a complete relocation of the roadbed. This has already been done on many trunk lines with commendable results.

A rather curious feature of the "blind turn" is that those of short, sharp curvature are safer than those with longer curvature as a rule. This is because the automobile driver is usually content to remain behind the slow plodding team until safely around the short turn whereas he loses patience on the long curve and attempts to dodge around the obstacle with the risky consequences. Also he must reduce his speed on the quick turn but not necessarily on the other to keep the equilibrium of his car.

When it seems impossible to change a bad turn the mixed traffic can sometimes be done away with entirely by sending the slow moving vehicles over an alternate route or vice versa. In many cases it would be possible to construct a special parallel carriage road around the turn on which the horse vehicles would be compelled to pass.

As far as signaling devices are concerned there are of course a great variety in use at the present time on the cars themselves but many of them are too small to be effective under bad conditions. Theoretically horns and similar devices should give sufficient warning on bad turns, but in actual practice, there are likely to be so many other confusing noises such as the rush of the wind past the ears, noisy motors or gears, rattle of teams etc. that they often go absolutely unheeded. Also, the loud, harsh tones necessary to secure effective response are constantly growing more and more of a nuisance to those unfortunates who reside near places requiring such strenuous horn signaling.

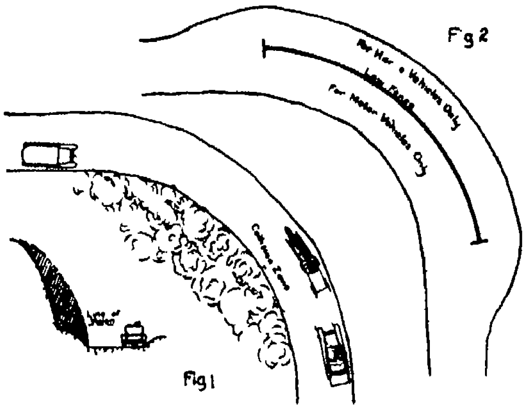


Fig. 1. A bad turn, and how the bank should be cut away to make it safer. Fig. 2. Complete separation of horse and motor traffic

On main trunk routes, where the amount of traffic will justify the cost, a form of semaphore signal, similar to those used on railroads, would be very effective. The signal would have two arms operated by a mechanical tripping device placed across the road at the proper distance from either end of the curve. The tripping bar could be set in a concrete or metal channel projecting above the roadbed just enough to make a satisfactory connection for an electric actuating mechanism when depressed by the weight of as light a vehicle as a bicycle. Such a signal would have to be used in connection with a dividing fence and the tripping bars would also be divided one for either roadway at both ends of the curve. Passage of the vehicle over the first bar would set the signal while the next bar would release it, just as in railroad work. The mechanism would have to be arranged so that if a second vehicle passed over the first operating bar before the vehicle immediately ahead of it had reached the end of the block the latter could not release the signal. Such a device would be particularly useful where there was much mixed traffic as it would safeguard against both head-on as well as rear-end collisions. It could be easily installed.

Finally the suggestion has been made of a form of inexpensive mirror placed at the center of the curve, so that it would clearly show an approaching driver what he would encounter around the turn. In fact, a metal surface with sufficient reflecting power to transmit the headlight glow in daylight would be sufficient, as it would give the driver all he needs—a warning. With the almost universal use of electric lights it would be very easy for the driver thus to protect himself were such a device installed and if an inexpensive satisfactory reflecting surface could be found for this purpose, no simpler remedy for the perils of the "blind turn" would be needed.

A bad "blind turn" of the "S" type. The operator has only 150 feet clear sight around the turn. Fig. 5 shows how it was eliminated

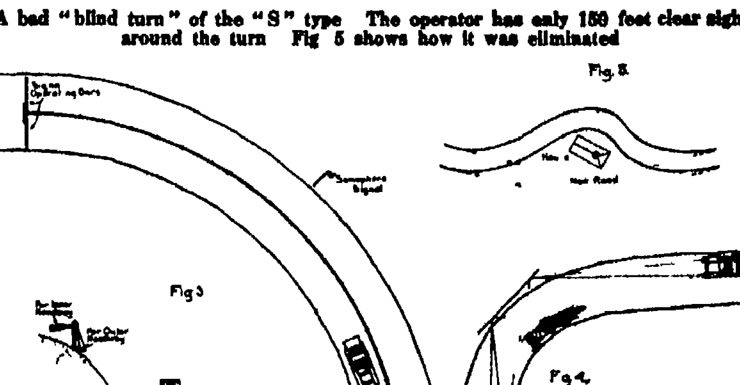


Fig. 3. Signal system of protecting a "blind turn." Fig. 4. How a reflector at the outside of the curve would aid traffic. Fig. 5. Dotted lines represent the new road built to eliminate the curve shown in the photograph

Father Time the Only Official Tester

By Alexander Winton

"WONDERFUL flexibility and perfect control at all speeds, absence of vibration, quiet running, greatest of hill climbers and record breaking speed."

One might easily suppose that these words sum up the merits of a 1916 model—a model that has reached new heights of excellence.

Yet I do not quote them from current automobile literature at all. Quite to the contrary the quoted paragraph is more than 12 years old and it tells a very truthful story of a car that, in spite of its super features, is to-day practically out of existence. I refer to the steamer.

The smooth continuous power stream of the steamer and its soft velvety flexible application have never been equalled in any other type of car. None has ever approached its superb demonstrations. It had the speed of a ghost, and hill-climbing ability that won contest after contest from gasoline cars with plenty of margin to spare. It was unquestionably the smoothest, swiftest thing on wheels.

Yet all these merits could not keep steam in the running. To-day the steamer is chiefly a memory. And that fact furnishes an important lesson.

Let me recall another instance of similar importance. In the earlier days it was a vital question among gasoline car makers whether the two-cycle motor would not put every other motor out of business. For the two-cycle produced power twice as often as the four-cycle (which is the only type now on the market). Where the usual type of gasoline motor had but four power strokes, the two-cycle had eight power strokes. And where the usual type had but six power strokes the two-cycle had twelve. And inasmuch as power is what motors are built to produce, it was clear that the two-cycle had a 100 per cent advantage.

But where are two-cycles to-day? I do not know of a single manufacturer who is now producing them—in spite of their apparent 100 per cent advantage. And the reason is that the power advantage of the two-cycle was more than offset by numerous disadvantages that car owners sooner or later discovered—at their own expense and annoyance. I need not go into details. Father Time is the only official tester of

(Concluded on page 48)

Development of the American Motor Car That Has Led Up to the V-Type Multi-Cylinder Motor

By J. G. Vincent

TO a person who has not made a close study of the many engineering problems involved in motor car design the reason for the present decided trend toward V type multi-cylinder motors is probably more or less obscure and he might well wonder whether future development of the motor car is going to call for a still greater number of cylinders

Engineers are of course directly responsible for the development of the motor car but practically every step taken by the engineers has been in response to some insistent demand by motor car users but I doubt whether any large percentage of these users have any very definite idea regarding the underlying principles of engineering that have been followed in producing a more satisfactory vehicle and with this thought in mind I would like to briefly discuss the development of the motor car in a more or less untechnical manner

In the early days of the motor car practically nothing was known about gasoline engineering and the pioneer engineers were confronted by many difficult problems at every turn It was necessary for them to grapple with unknown quantities in carburetion ignition valve arrangement valve timing lubrication and various other details of construction which while they look simple now were nevertheless very difficult problems to solve at that time The problem at that time was to make a motor that would run and give a reasonable degree of power and reliability

The Elementary Motor

The simplest form of gas engine is of course the single cylinder and it was with this type of engine that most of the experimental work was done in an endeavor to solve the above mentioned problems As soon as these problems had been partially solved and the single cylinder engine had been made a reasonably reliable piece of mechanism the demand from users for more range of ability greater smoothness and less noise began to be heard and although engineers have accomplished rapid and consistent improvement year by year still the same demand has continued

First Efforts to Improve

Fig 2 shows the arrangements of the two cylinder opposed engine which type was finally adopted for this number of cylinders after the public had given its verdict against two cylinder engines with the cylinders side by side Two arrangements of the latter were tried out in one the cranks were opposite and the working strokes both occurred in one revolution, leaving

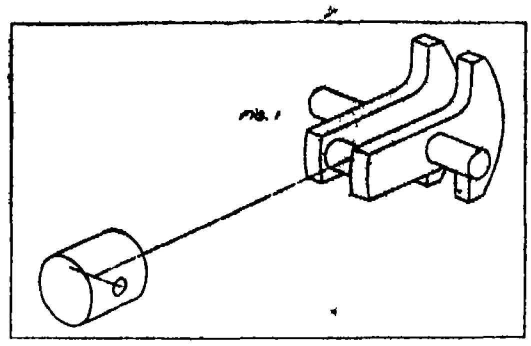


Diagram illustrating the relations of the piston and crank of a single cylinder motor

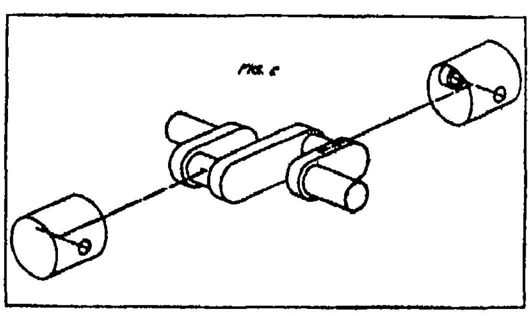


Diagram illustrating the relations of the pistons and cranks of a 2-cylinder opposed motor

The Driving Train Developed

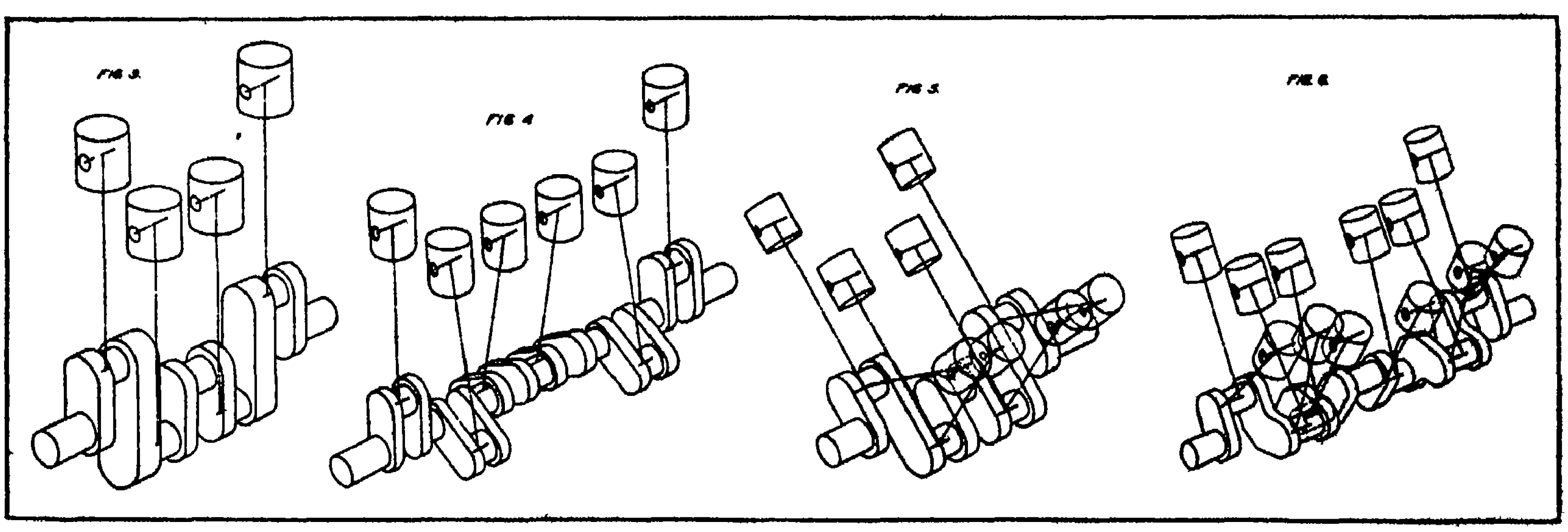
With the definite standardization of position for the crank shaft, the entire driving train of the car has been developed accordingly This consists of a clutch immediately in the rear of the motor then a change speed gear box with a universally jointed shaft, to take care of rear spring action either between it and the clutch or between it and the bevel gears, next, the bevel gears, worm bevels or worm and wheel which change the motion to rotation parallel to the axles. Differential gears which take care of the difference in speed of the rear wheels when turning corners are located within the driven bevel gear In the early stage of development the driven bevel gear was on a jack shaft which drove the rear wheels by means of side chains. This simplified the engineering problems inasmuch as the twisting strains were not combined with the bending strains in the rear axle resulting from the weight of the car Engineering progress has however taught us to combine these functions satisfactorily and the side chains have now been generally discarded with the result of less noise greater durability and less complication

A small four cylinder engine when carefully constructed is without disastrous vibration and capable of rotative speeds as high as have ever been obtained. On these motors practically perfect synchronism of ignition was first generally obtained by the use of the magneto

The First Efficient Motor

Comparative quietness was first possible with four cylinder motors and in consequence many details were first refined in this type of motor

Although high speeds are obtainable with a small motor of this type and as mentioned above it has no rocking couple still it has a secondary vertical vibration which gives an impression of roughness and is objectionable in motor carriages This is caused by the movement of the combined center of gravity of the pistons due to the angularity of the connecting rods. This principle is somewhat involved and I will not attempt to explain it here.



Diagrams illustrating the relations of the pistons and cranks of a 4-cylinder, a 6-cylinder, an 8-cylinder V-type and a 12-cylinder V-type motor, respectively

The principal moving parts of a single cylinder engine are indicated in Fig 1 They were appropriated from stationary engine practice in which variability of speed high speed and saving of weight were no object. In consequence the reciprocating parts were very heavy and vibrated so badly that what would now be considered as comparatively low rotative speeds were impossible Counterweights were used as a crude device for reducing the vibration but reciprocating parts connected to a crank by a pitman or connecting rod cannot be balanced by revolving weights and the result was unsatisfactory On the other hand, the limit of low speed depended upon the size of the flywheel which had to be made extremely large because each cylinder makes only one working stroke in two complete revolutions and the flywheel therefore, had to drive the car three quarters of the time; consequently the progress of the car at low speeds was very jerky because of the varying torque delivered The public understood these simple things and the most momentous question to be decided was whether the increase in range of ability smoothness and reduction of noise which every one knew could be accomplished by adding a second cylinder would justify the complication.

the flywheel to drive the car for the next revolution In the other arrangement the working strokes or impulses were equally spaced but this required the cranks to be side by side and the vibration of the reciprocating parts was just as bad as in the single cylinder engine In the two cylinder opposed engine on the other hand, the impulses were equally spaced and direct vibration due to main reciprocating parts was entirely eliminated. The only vibration remaining was what is known as a rocking couple This rocking couple was not very bad; in any case the general effect was so much more smooth than that obtainable with the single cylinder engine that the rocking couple was not seriously objected to. This is the only form of motor which contains a rocking couple that has at any time had the general approval of the American motoring public The rocking couple however resulted in condemnation of the three cylinder vertical engine and many other engines which have never got beyond the experimental stage.

Fig 3 shows the vertical four cylinder engine, which completely revolutionized the construction of practically the entire automobile. This is the standard motor to-day for commercial vehicles and small inexpensive motor carriages.

To sum up the situation as it stood after the four cylinder motor had been thoroughly developed, we find the following

We had arrived at a standardized general arrangement of the different motor car units. We had arrived at very satisfactory carburetion ignition, lubrication valve action, cooling and various other details of motor construction. We had arrived at a reliable form of motor giving a fair degree of smoothness, providing such motor was not made too large or run at too high a speed.

More Ability Demanded

The public, however was still calling for more range of ability greater smoothness and less noise, and an attempt was made to give more range of ability, by making the four cylinders larger, but it was found that the increase in secondary vibration, due to the increased weight in the larger pistons and connecting rods was prohibitive, and it was also found that there

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The Heavens in January

The Coming Lunar and Solar Eclipses

By Prof. Henry Norris Russell, Ph. D

THE principal event of this month, from the stand point of the amateur star gazer, is the eclipse of the moon, which happens on the morning of the 20th. The eclipse of the sun, which follows, on February 3rd, may also be described this month, for otherwise our account might not reach our more distant readers until after the eclipse was over

The lunar eclipse is partial—only about one seventh of the moon's diameter being immersed in the earth's shadow The moon first reaches the penumbra, or outer fringe of the shadow, with which a part of the sun appears to be concealed behind the edge of the earth, at 1 05 A M Eastern Standard time on the morning of January 20th Though for an observer at the proper point on the moon's surface at the southeastern edge of her visible disk an eclipse of the sun would begin at that moment, the terrestrial observer will see nothing unusual for some time later The reason for this is that at first only a small portion of the light of the sun is cut off, even from the advancing edge of the moon, and the diminution of the brightness of the lunar surface is correspondingly small But as the moon gets deeper into the penumbra and more and more of the sunlight is cut off the darkening of her surface on the eastern and southeastern side becomes conspicuous Finally at 1 55 A M her southeastern limb reaches the edge of the umbra or shadow proper and gradually dips deeper and deeper into it

The center of the earth's shadow is so far south of the moon that she hardly more than grazes it, but at the middle of the eclipse, which occurs at 3 40 A M the gap "bitten out" of her southern edge will be big enough to attract attention even at a casual glance On account of the action of the earth's atmosphere in refracting sunlight into the shadow, this obscured region will not be wholly dark but it will be so faint, compared with the directly sunlit portion of the disk, that it will be visible only with difficulty

As the moon recedes from the center of the shadow, the gap bitten out of her edge slowly shrinks, and its last traces disappear at 4 24

The darkening by the penumbra now on the southwestern side persists for some time longer, but it will become imperceptible to the eye considerably before the last traces of it theoretically, disappear at 5 14 A.M

The solar eclipse of February 3rd is a much more important affair being total along a path some 9,000 miles long and from 50 to 100 miles in width Beginning far out on the Pacific this track runs over the ocean—here barren of islands—and the first land it reaches is the South American coast, about 200 miles south of Panama Crossing the northern portions of Colombia and Venezuela in a northeasterly direction, it escapes into the Caribbean Sea not far from Curaçao and reaches the West Indian Islands passing over Guadeloupe From there onward its course lies again over the unbroken ocean missing the westernmost of the Azores by only a few miles and leaving the earth as the sun sets a couple of hundred miles south of Iceland

The duration of totality is about two minutes and a half both in South America and the West Indies, with the sun high in the sky, so that this eclipse is as favorable for observation as many which astronomers have traveled thousands of miles to see On account of the present European situation it is not probable that any party will cross the Atlantic to observe it, and little or nothing has been heard of any plans for expeditions from this country Any one who is planning a trip to Caribbean waters this winter, however though the veriest novice in astronomy, will do well to arrange his itinerary so as to be in the zone of totality on February 3rd Even with unfavorable weather the mid-day darkness is impressive, and, with clear skies, the spectacle is one of the most magnificent which nature affords.

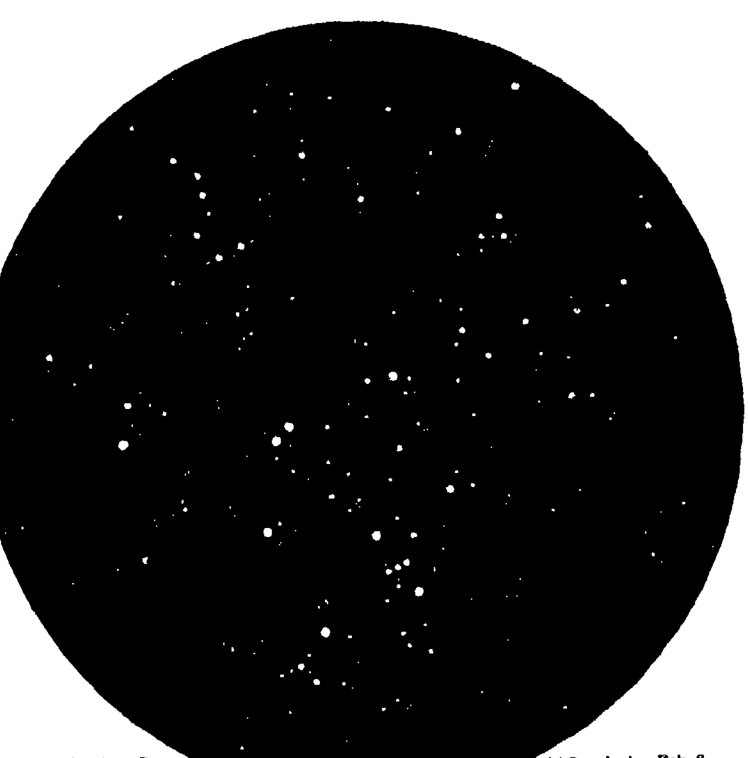
The strange colors which sky, land and sea take on, a few minutes before totality, in the light from the edge of the sun, the rapid advance of the shadow, like a vast thunderstorm on the western horizon, but moving infinitely faster, the sudden darkening of the whole landscape, as on a train entering a tunnel; the appearance of the planets and brighter stars, and of the mysterious corona surrounding the dark moon then the return of sunlight and of normal conditions—these form a memorable experience, worth a long journey to undergo

As the sun-spot activity is now rapidly increasing, the corona will, in all probability be fairly bright, and irregular in form Mercury, which is near inferior conjunction will be about 5 deg northeast of the sun, but by no means brilliant, being a narrow crescent. Venus and Jupiter 30 deg and 10 deg east of the sun, should also be conspicuous These are probably the only objects that will be visible at a glance Though Fomalhaut, which will be about 30 southeast of the sun and Altair about as far northwest of him will probably be easily enough seen if one knows where to look for them

Observers in the United States will see only a partial eclipse

For stations on the Atlantic seaboard, nearly half the sun's diameter will be obscured at the maximum phase Farther north and west the eclipse will appear smaller but an eclipse of some sort will be visible all over this country and Canada, except on the Pacific Coast, where the sun does not rise till the eclipse is over

At Washington the eclipse begins at 10 11 A M by Eastern Standard time and ends at 12 22 P M The times of beginning and ending, though varying from station to station, will be within half an hour of this all through the Eastern United States.



At 11 o'clock Jan 7
At 10½ o'clock Jan 14
At 10 o'clock Jan 22

At 9 o'clock Feb 6
At 8½ o'clock Feb 14
At 8 o'clock Feb 21

At 9½ o'clock January 29

NIGHT SKY JANUARY AND FEBRUARY

The Heavens

As one map shows, the finest constellations are now in the southern sky Orion rides high on the meridian. Below him, and a little to the left, is Canis Major, the Dog which forever pursues the Hare, Lepus—a smaller and fainter constellation to the westward. Below Lepus is the small group of Columba, the Dove, which possesses one conspicuous star, while below Canis Major, and far to the eastward extends the huge length of the Ship Argo—the greatest constellation in the heavens—most of which lies too far south for us to see it well, if at all To facilitate the naming of the very numerous stars in this large region, the constellation has been divided into three parts: *Puppis* (the stern), *Carina* (the keel) and *Vela* (the sails). Most of the stars visible to us belong to the first of these divisions, while the third is entirely below the horizon of New York.

A line drawn from Betelgeux in Orion through Sirius and continued as far again, points out the second-magnitude star Zeta Puppis. Below this, close to the horizon, and only visible on the clearest nights, in our latitude, is Gamma Velorum These two stars are noteworthy as being the brightest in the heavens, which possess certain peculiarities of spectrum—known technically as "spectra of the fifth type"—which indicate that they are, in all probability, the very hottest of the stars.

To the west of these stars, and still farther south, lies Canopus—Alpha Carinae—the brightest star in the heavens, excepting Sirius alone. It is invisible in the latitude of New York, but may be seen, low on the horizon, from points south of Virginia, and is a conspicuous object in latitudes below 30 deg.

All three of these stars have exceedingly small proper-motions, and are undoubtedly very remote. Canopus, in particular, must be of enormous real brightness—probably at least 10,000 times as bright as the sun

Above Orion, and nearly overhead, are Gemini, Taurus and Auriga—the last beyond the zenith, on the northerly side To the east is the inconspicuous group of Cancer, and the prominent one of Leo, while the head and about half the body of Hydra fill the southeast. Mars, which is in Leo, and Saturn, in Gemini, further adorn this part of the sky, exceeding in brightness all the stars but Sirius.

In the northeast, the Great Bear is slowly coming up, with Draco and Ursa Minor following, below the pole. Cassiopeia and Cepheus are sinking in the north west. Pegasus is setting a little north of west Perseus and Andromeda are above, and Aries and Pisces to the left

The great blank in the southwestern sky is occupied by Cetus and Eridanus—neither of them containing any bright stars visible in our latitude, but notable because the stars τ Ceti and ε Eridani are the nearest, so far as known, of any visible to the naked eye in this latitude, except Sirius They are each at about ten light years distance, as is Procyon also

The Planets

Mercury is an evening star all through January, and is best visible on and about the 20th, when he is at his greatest elongation Since he is then near perihelion, he is unusually near the sun—in the sky as well as in space—his maximum distance being only 18° 40′, but he is north of the sun, and remains in sight for nearly an hour and three-quarters after the latter has set, so that he should be easily visible

Venus is also an evening star, far to the east and north of the sun, and very bright As she comes north, she remains longer and longer in sight each night, till at the end of the month she sets fully three hours later than the sun

Mars is in Leo, approaching opposition, and rises about 8 40 P M on the 1st and 6 10 on the 31st. He is brighter than any star except Sirius, even at the beginning of the month, and doubles in brightness before its close, as his distance from us diminishes from 77,000,000 to 64,000,000 miles.

Jupiter is evening star in Pisces, setting at 10 P.M. in the middle of the month He is brighter than anything else in the sky except Venus.

Saturn is in Gemini, and is in opposition on the 5th. He is brighter than Capella, and is visible all night long, affording one of the most beautiful of telescopic objects.

Uranus is in Capricornus, too near the sun to be seen easily, if at all, with a field glass. Neptune is in Cancer, and comes to opposition on the 22nd.

His position on the 1st is in 8h. 16m. 11s. R. A. + 19° 27′ 15″ north declination, and on February 2nd in 8h. 12m. 32s. + 19° 39′ 14″—which puts him about 3 deg. northwest of the well-known triple star Zeta Cancri.

The Moon is new at 11 45 P M. on the 4th, in her first quarter at 10 38 P.M. on the 11th, full at 8:29 A.M. on the 20th, and in her last quarter at 7.35 P.M. on the 27th. She is nearest the earth on the 4th, and farthest away on the 17th. As she moves around the sky she passes near Mercury on the 5th, Venus and Uranus on the 7th, Jupiter on the 10th, Saturn on the 18th, Neptune on the 20th and Mars on the 22nd.

(Concluded on page 46)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

FOLDABLE GARMENT HANGER.—L. KALINA, 384 Alabama Ave, Brooklyn, New York, N Y. This invention provides a hanger more especially designed for supporting trousers and like garments, and arranged to fold into a comparatively small package for conveniently carrying it along in a pocket, valise trunk or the like, and adapted to be readily extended and hung up for use on a hook or other suitable support.

ARCH SUPPORT.—EDITH P CUSHMAN, 70 Broadway Methuen Mass. The support is so arranged that it will afford a firm yet yielding support for the distal ends of the third and fourth metatarsal bones, which lack the thickness and heaviness of the first and second bones, and are supported by the muscles and ligaments, to relieve the strain on such muscles and ligaments, and to permit the third and fourth toes to assume their natural straight position.

TOE SEPARATOR.—A WEIL, care of Fredérick Victor and Achellis, 18 W 22nd St, New York, N Y. Among the principal objects which this invention has in view are: to provide a convenient and efficient filler for the spaces between the toes to prevent crowding together of the same and to provide a spreader of the character mentioned adapted to be worn inside a shoe.

Electrical Devices

ELECTRIC SWITCH.—A J TISLEY, 36 W 15th St, New York, N Y. The object here is to provide a switch particularly well adapted for use on candelabra in which a switch member is mounted to rotate on a central tube through which the wires lead, one of the wires being connected with the switch member for making and breaking the circuit.

SNAP SWITCH.—H K ELY, Baltimore, Md. This invention has reference to improvements in electric switches, more particularly to those switches of the so-called snap switch type, in which the pressure of a button causes a quick movement of the switch to connect or disconnect an electric circuit.

Of Interest to Farmers.

DISK JOINTER.—S H PHELPS, care of Mount Plow Works, Evansville, Ind. Means provide for sustaining the disk with increased rigidity and for adjusting the securing means in various directions and at various angles to compensate for any deformity in the plow beam, and to position the pointer in proper relation to the plow to insure a clean path for the plow by cutting the trash and at all times turning the trash toward the furrow far enough to be completely turned under by the plow.

BOX PRESS.—C B RUMSEY, Tampa, Fla. This invention relates to presses used for clamping and pressing down the covers of boxes while being nailed, and in its preferred form the invention is more particularly designed. The clamp elements are mounted for movement to and from the box support of the press, as usual, and have in addition, a secondary sliding movement in the direction of their axes.

Of General Interest

CAMERA.—A F KELLOGG, Portage, Wis. Mr Kellogg's improvement consists of a shutter for excluding the light from the light carrying tube when the device is not in use and means for automatically opening the shutter when the device is in use, through the medium of a pencil or stylus the movements of which are duplicated by the light carrying tube.

OIL CUP.—L. C DUTRO, Kingman, Ariz. This invention provides an oil cup which will deliver oil to a bearing only at the time and in the degree of need, provides means for adjusting the relationship between the need and the feed of the oil, and provides such oil cups which are simple in construction and positive in action.

HORSESHOE.—T B. MASON, 209 South Warren St, Trenton, N J. The invention provides means to facilitate the attachment of the shoe in position and to hold it firmly, and provides an overshoe and attaching means so formed and arranged that the overshoe will be positioned adjacent to the heel or heel calk of the ordinary shoe. The overshoe or auxiliary shoe is to be worn in connection with the regular shoe, particularly to prevent slipping on ice or snow in winter weather.

PRINTING CAMERA.—J TRIMBACH, Rye, N Y. The device is primarily adapted for use in a dim light, as is usual with gas light papers, but the device contains the printing light or lamp, as well as a non actinic lamp which may be used to position the negative and positive sheets, after which the white light is turned on and the printing begins.

SUPPORT FOR AWNING TOPS.—M DOW, 11K Henniker, N H. This improvement has reference to awning supports and has particular reference to appliances for hanging awnings to or removing the same from a building with the minimum amount of trouble and expense of time and without the necessity for using any tools whatever.

POISON BOTTLE.—M J DRISCOLL, Cristobal, Canal Zone. The prime object of the invention is to provide a bottle that may be utilized for containing poison and so formed as to insure that its contents will be used only with deliberation, thereby preventing the accidental taking of the poisonous contents in mistake for non poisonous substances.

COUPLING.—I F TARBERT, 505 Sparkman Ave, Tampa, Fla. This invention dispenses with the use of rings and the like for retaining the socket member in engagement with the ball member, said rings oftentimes becoming loose and rendering the joint defective. This is accomplished by the provision of a detachable section for the socket member having a pivotal connection with the same and adapted to effectively coöperate with the main portion of said member to retain the ball member in engagement therewith.

CURRENCY WRAPPER.—T P MARTIN, JR, care of Oklahoma Stock Yards National Bank, Oklahoma, Okla. This improvement provides a wrapper which owing to the manner in which it is creased or scored may be folded to form a wrapper for various sized packages and which may be quickly and positively secured in position so as to form a neat and compact package suitable for shipment through the mails.

THERMO HYGROSTAT.—F M JONES, 168 West Maumee St, Adrian, Mich. The invention relates to improvements in devices for automatically regulating the temperature and humidity of the air in sleeping rooms, living rooms, hospitals, etc. The device operates positively to regulate the hygrostatic conditions without the necessity of frequent adjustment.

EGG CASE.—A. J COUGHENOUR, Fort Sheridan, Ill. This case is especially adapted for the transportation of eggs, incandescent light bulbs, bottle goods, and like fragile articles by parcels post, express or the like, wherein an outer casing is provided in which is arranged a carrier containing separate compartments for the individual articles. Cushioning mechanism provides against shock or jar of impact is not transmitted to an article.

CIGARETTE BOX.—D STOLL, 57 Hope St, Brooklyn, N Y. This invention comprehends the provision of a box designed to contain cigarettes or the like in spaced relation and to project the same, one above the other, in staggered relation or otherwise such that the convenient withdrawal of the cigarettes independently, can be accomplished.

APPARATUS FOR FILLING RECEPTACLES WITH LIQUID.—O WICKHAM, 21 Creffield Road, Ealing, London, England. This invention relates to apparatus for filling bottles, jars, and other receptacles with liquids. The essential feature is the use in such an apparatus of a siphon having a single outlet or long leg and a double inlet or short leg each of said short legs or short leg members communicating with a separate vessel or source of supply.

MANUFACTURE OF NATURAL ICE.—E. SEAVEY, 116 W 102nd St, New York, N Y. The object of this invention is the provision of certain new and useful improvements in the manufacture of natural ice during the cold season and whereby the water is quickly frozen into blocks or cakes by the use of an inexpensive apparatus.

LOOSE LEAF STATEMENT BOOK.—L. C VAN VOORHIS, care of Walker Bros, Bankers, Salt Lake City, Utah. The inventor provides complete sheets of varying sizes so that when all are located in the same position with respect to the book they are automatically positioned with respect to one another so that the overlapping and indexing thereof are accomplished. In the present arrangement each division of the book, constituted by a series of leaves, is of the same thickness at one end as it is at the central point and all of the statement sheets when detached are of uniform size.

SEWER CONSTRUCTION.—W B GRAY, 1327 South 22nd St, Louisville, Ky. This invention provides a construction composed of individual units in the form of blocks or sections wherein the blocks are so constructed and arranged that each block interlocks with all of the adjacent blocks to resist stress in any direction but to especially resist crushing stress.

WATER SUPPLY SYSTEM.—L. A NITSCHE, 703 South Houston Ave, Tulsa, Okla. This invention relates more particularly to the construction of wells of a stable, permanent nature in shifting soils such as quicksand, the primary object being to provide for the formation of such wells without the necessity for the use of pile drivers and other expensive and cumbersome apparatus such as is now necessary for this purpose.

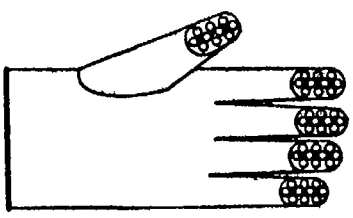
BARREL HEAD.—H FELLIS, 14613 Westropp Ave., Cleveland, O. An object here is to provide a barrel head which is especially adapted for steel barrels or other receptacles containing liquids such as paint or varnish, having means for locking the head of the barrel and for unlocking it when it is desired to have easy access to the contents of the barrel.

FRUIT WASHER.—F C RANDALL, Benton Harbor, Mich. This improvement pertains to the washing of fruits, vegetables, etc., and the main object thereof is to provide a device of this class wherein the articles being washed are caused to revolve in a flow of water to present all portions of their surfaces to the flow or force of the water whereby they will be thoroughly cleansed of all foreign matter.

PENHOLDER.—A BORSELLA, 519 W 134th St, New York, N Y. This inventor provides an arrangement which will guide the hand in properly holding the pen. He provides a penholder with a plurality of guiding lugs against which the thumb and certain fingers press when the holder is in use, the same causing the pen to be properly grasped and held at a proper angle.

DRINKING GLASS HOLDER FOR STERILIZERS.—P S GRAVES, Address James I. Ollivetti, Plattsburg, N Y. The invention provides a device whereby drinking glasses and the like may be easily and quickly placed in or removed from the holder, and by means of the latter easily and quickly placed in or removed from the sterilizing tank for the purpose of sterilizing glasses, the holders preferably being of metal so that they act as conductors which are in contact with the glasses so that the heat is readily conducted away from the latter by the holder and its handle to thereby prevent cracking of the glasses by the intense heat.

MASSAGE GLOVE.—W R NORTON, Hightstown, N J. Mr Norton's invention relates to massage gloves having a receptacle or receptacles adapted to accommodate a substance or substances employed during the massage with the glove. He provides a simple and inexpensive glove having one or more receptacles associated therewith, which receptacles are elastic



MASSAGE GLOVE.

and which are easily filled with a desirable substance and from which the substance can be easily fed from the feed easily controlled by the party wearing the glove.

Hardware and Tools

TOOL FOR INSERTING SPRINGS IN EYEGLASSES.—A. R FRISTEL, Weston, W Va. This tool is for use for placing the spring wire employed in the springs of eye glasses of the Shur-on type wherein a holder is provided for supporting a reel of the wire, and having means for feeding the wire and wherein a cutter is mounted on the holder for cutting the wire, arranged to be normally held in inoperative position, and to be moved into position and operated to cut by the same moving means, to permit the insertion of the spring with one hand, leaving the other free to hold the glasses.

DOOR PIVOT.—J A CROSS, Westwood, N J. This improvement refers to pivots for doors or similar closures which pivot is adapted to raise the door or closure bodily when the same is moved to the closing position, whereby the door or closure is jammed into the frame and thereby locked in the closed position.

Heating and Lighting.

AIR VENT VALVE.—W SHURTLEFF, address Moline Vacuum Vapor Heating Co, Moline, Ill. This valve is especially adapted for use with two-pipe heating plants, and with steam heating systems, wherein the valve is so arranged that it will permit the discharge of air during heating of the system, while when steam enters the valve the increase in heat will close the valve, to prevent the escape of steam and to prevent at all times the discharge of steam from the system, and return the condensed steam to the boiler.

OIL GAS BURNER.—R. I. BLUMBERG, 27 Liberty St., New York, N Y. The invention provides a device for use in all makes or styles of stoves, heaters, ranges, furnaces and boiler heaters, means being provided to convert the present heating appliances, where coal, coke, wood or the like are used, into fuel oil burners with a corresponding economy of fuel cost and increase of convenience and efficiency.

COMPRESSED GAS HEATER.—J J YAGER, 517 W Loucks St., Sheridan, Wyo. This invention relates to an electric heater for use in connection with carbonating apparatus for preventing freezing at the regulator or expansion valve, which is a well known difficulty in apparatus for bottling soft drinks and charging soda water fountains with gas under compression.

GAS HEATER.—J T RENNOS, Mercer, Pa. This improvement refers particularly to gas heaters of the reflector type, and an object is the provision of means whereby proper combustion of the gas will be maintained and, interference with the flame of air currents and eddies will be prevented.

SHADE HOLDER.—M F. FINKELSTEIN, 84 Walker St, New York, N Y. The invention has reference more particularly to a device which comprises a body adapted to be associated with the lighting fixture, and having a shade receiving ring, a band adapted to encompass a part of the shade and to hold the same relatively to the ring, and means for tightening the band and for securing it, the ring having a part engaging the band and serving to guide and hold the same when it is being operated.

HANGER FOR ELECTRIC LAMPS.—MARTIN L. NEWELL. Address E. S. Higgins, 110 Washington St., Paris, Tenn. The invention is an improvement in that type of hangers for electric lamps which may be raised and lowered to suit convenience. It is distinguished by adaptation for suspension from a tack, nail, or screw, so that it may be conveniently transferred from one portion of a room to another.

STOVE DOOR KNOB.—C. E. [illegible], Hobart, Wash. This improvement relates to a knob adapted to be applied to standard makes of stove doors. The prime object is to provide a knob so formed and arranged as to be effectively insulated from the metal parts of the stove and door to prevent the undue heating of the knob.

ELECTRIC HEATING AND COOKING STOVE.—L. P. HAYS, Idaho Springs, Col. The invention relates to an electric stove for room heating and cooking purposes, and it embodies an electric coil arranged within a casing through which air circulates and is effectively heated by the coil when this latter is traversed by current.

Household Utilities

SAD IRON.—S. GOLDSTEIN, 208 E. 5th St., New York, N Y. This invention relates to sad irons heated by the combustion of gas within the iron. The object is to provide a simple, strong, efficient, and inexpensive iron, in which the flame is generated by a burner located within the iron, said flame playing against a perforated false bottom of the iron.

SEDIMENT COLLECTING DEVICE AND WATER INLET VALVE FOR KITCHEN BOILERS.—J. F POLMANN, care of Polmann & Sons, East Rutherford, N J. This invention relates to a valve device for use in connection with kitchen and other boilers for preventing the circulation of sediment through the boiler system and for enabling the collected sediment to be drawn off from time to time in a simple, convenient and efficacious manner.

FLUSHING VALVE.—C S. C. ROCK, 204 W 140th St., New York, N Y. This invention relates particularly to flushing valves for toilets or the like. An object is to provide a main valve construction embodying two oppositively disposed valve seats and an internal movable chamber whose walls are adapted to coöperate with said valve seats in alternation.

Machines and Mechanical Devices

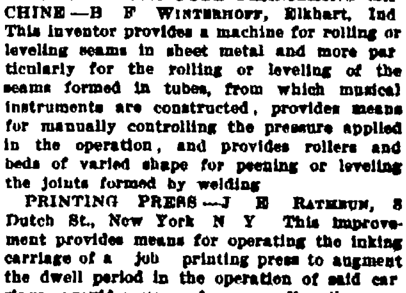
WELL CASING PERFORATOR.—A. C. GRAHAM, 311 Cherokee Ave., Bartlesville, Okla. The prime object of the present invention is the provision of a perforator employing a plurality of wheels, and the provision for actuating the same without the employment of individual elevators for individual wheels, whereby the construction is greatly simplified and a more direct and positive perforating movement is imparted to the wheels.

APPARATUS FOR DRYING SAWDUST.—H C JOHNSON, Fort Bragg, Cal. The purpose here is to provide a device having mechanism for taking the waste sawdust of a saw mill thoroughly drying the dust removing splinters and other foreign bodies, and delivering it finally in condition for packing fruit and like products.

SHEET METAL TUBE PLANISHING MACHINE.—B F WINTERHOFF, Elkhart, Ind. This inventor provides a machine for rolling or leveling seams in sheet metal and more particularly for the rolling or leveling of the seams formed in tubes, from which musical instruments are constructed, provides means for manually controlling the pressure applied in the operation, and provides rollers and beds of varied shape for peening or leveling the joints formed by welding.

PRINTING PRESS.—J E RATHBUN, 8 Dutch St., New York, N Y. This improvement provides means for operating the inking carriage of a job printing press to augment the dwell period in the operation of said carriage, provides means for suspending the operation of said carriage and to avoid wear of the carriage-operating connecting member; and increases the output of the press by increasing the speed of operation thereof.

TRANSMISSION MECHANISM.—E. A MINOR, Box 52, Wilder, Vt. This invention has for its main object the provision of means whereby the speed of transmission may be made variable in desired degrees of the driven element with respect to a constantly operated

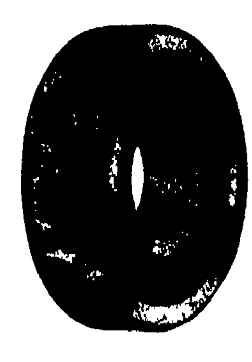


TRANSMISSION MECHANISM.

driving element. This is accomplished through what is technically known as a planetary gear and a pump gear, operating as a variable brake therefor. The invention provides external means for varying the effect of said pump gear.

MACHINE FOR MAKING BASKET BLANKS.—O. E. ST. JOHN AND F NORTON. Address the former, Box 646, Canisteo, N. Y. The invention relates more particularly to a machine for weaving to form blanks from which the usual splint baskets are thereafter made up. The primary object is to provide a machine capable of a continuous automatic operation from the time when the splints are fed into the machine until the woven blank is discharged therefrom.

TRANSMISSION GEAR [illegible].—F. W. WOODRUFF, [illegible], Cal. [illegible]



A Car for Every Prospective Purchaser

American Gasoline Pleasure Car Manufacturers with Prices of Their Leading Models for 1916

Compiled by C Edward Palmer

ONLY three or four years ago it was the custom to refer to the automobile business as the infant industry of the country But it has made such rapid strides, not only in the number of cars made and the number of factories, but in the evolution from the first crude engine to the present-day, highly efficient machine, that this youngster of commerce has become one of the giant industries of the country The cars manufactured have become so numerous and the prices so diversified that a man who contemplates the purchase of a car has only to name his own price and then proceed to pick from a dozen or so within that figure

The following table has been compiled with the purpose in view of assisting the visitor at the Automobile Show to see at a glance what cars are listed in the neighborhood of the price he has in mind The figures were compiled from data supplied by the manufacturers themselves and any which do not appear have been omitted only because the information was not supplied or not received in time to be included in the list

The table is self-explanatory, except for the abbreviations used In each of the six price columns the first figure indicates the number of cylinders, and the second figure the horse-power rating The letters refer to the type of body of the car at the price given That is, r means roadster t, touring car, c, coupe, l, limousine, s, sedan, b, berline.

Name of Car	Name and Address of Manufacturer	Under $600	$600 to $1 000	$1 001 to $2,000	$2,001 to $3,000	$3 001 to $4,000	Over $4,000
Allen	Allen Motor Co Fostoria Ohio		4 37 r t $795				
Alter	Alter Motor Car Co Plymouth Mich		4 30 t $685				
Apperson	Apperson Bros. Auto Co Kokomo Ind			6 45 t $1,550 8, 58, t $1,850			
Argo	Argo Motor Co Inc Jackson Mich	4 22 r $445 4 22 t $495					
Auburn	Auburn Automobile Co Auburn Ind		4 38 r t $985	6 38 r t $1 050 6 40 r t, $1,375	6, 40 l, $2,700		
Austin	Austin Automobile Co. Grand Rapids Mich				6 36-66 r t, $2,800	6,48-66, r, t, $3 600 6 36-66 l $4,000	6, 48-66, l, $4,800
Halladay	Barley Mfg Co Streator Ill			6, 40 r, t, $1,395	6 50 r t l $2 285		
Glide	Bartholomew Co, Peoria Ill			6 40 t, $1 095			
Bell	Bell Motor Car Co York Pa		4 30 r t $775				
Biddle	Biddle Motor Car Co Philadelphia Pa			4, 48 r $1,775 4, 48 t $1 800			
Briscoe	Briscoe Motor Co New York City		4, 38 r t $750 8 38 r t $950				
Lambert	Buckeye Mfg Co. Anderson Ind		4 30 r t $685 6 35 r t $985				
Buick	Buick Motor Co Flint Mich		6 25, r $950 6 25 t $985	6 25 r, $1 350 6 34 t $1 485			
Burrows	Burrows Cycle Car Co Ripley N Y	2 13 t $375					
Cadillac	Cadillac Motor Car Co Detroit Mich				8 60 r t, s $2 080 8 60 c $2 800	8 60 l $3 450 8 60 b $3 600	
Brownie	Carter Mfg Co Hannibal Mo		4 38 t $735				
Case	J I Case T M Co Racine Wis			4, 40 t, $1 090			
Chadwick	Chadwick Engineering Works Pottstown Pa						6 60 r t $5,500 6, 60 l, $6,500
Chalmers	Chalmers Motor Co Detroit Mich			6 25 t $1,050 6 28 r t l, $1,850			
Chandler	Chandler Motor Car Co Cleveland O			6, 35 r t $1 295 6 35 c $1 950	6 35 s $2 250 6 35 l $2 450		
Chevrolet	Chevrolet Motor Co of N Y New York City	4 20 t $550	4 22 r $720 4 22 r t $750				
Cole	Cole Motor Car Co, Indianapolis Ind			8 70 r t $1 785	8, 70 r c $2 185 8 70 t s $2 385	8 70 l $3 250	
L. W C	Columbia Taxicab Co St. Louis Mo					4 27 l $3 500	
Partin-Palmer	Commonwealth Motors Co Chicago Ill	4 28 r $495	4 34 t $675 4, 38 t $975	8 45 t $1 195			
Abbott-Detroit	Consolidated Car Co Detroit Mich			6 44, r t s $1 195 8 80 r t $1 950			
Crawford	Crawford Automobile Co Hagerstown Md			6 40 r t s $1 650			
Crow Elkhart	Crow Motor Car Co Elkhart Ind		4 30 r t $725 4 30 s $89[illegible]				
Monitor	Cummins-Monitor Co. Columbus, O		4 30 r t $795 6 40 r t $895				
Cunningham	Cunningham, James, Son & Co Rochester N Y					4, 36 r $3 500 4, 36 t $3 750	4, 36 l $5 000
Daniels	Daniels Motor Car Co Reading Pa				8 34 t $2 350		
Vixen	Davis Mfg Co Milwaukee Wis	4, 14, r $395					
Davis	Davis Geo W Motor Car Co Richmond Ind			4 23 t $1 165 6 29 t $1 495			
Dispatch	Dispatch Motor Car Co Minneapolis Minn		4 30 r $935	4 30 t $1 010 4 30 c $1 200			
Dodge Brothers	Dodge Brothers, Detroit, Mich		4 35 r t $785 4 35 r t $950				
Dodge	Dodge Motor Car Co Detroit, Mich	4 25 r $400	4 25 t $640				
Dorris	Dorris Motor Car Co St. Louis, Mo				6 38 r t $2 475	6 38 c $3 250 6 38 l $3 675	
Dort	Dort Motor Car Co Flint, Mich		4 30 t $650				
Sharon	Driggs-Seabury Ordnance Co Sharon Pa	4 10 r $395					
E. I M	Eastern Indiana Motor Car Co Richmond Ind	4 18 r $450					
Empire	Empire Automobile Co, Indianapolis Ind		4 24 r t $935	6 22 t $1 095			
Enger	Enger Motor Car Co, Cincinnati O			12 33 r t $1 095			
Fiat	F I A T Poughkeepsie N Y						4 50 r t $4 850 6 50 r t, $5,350
Farmack	Farmack Motor Car Corp Chicago Ill		4 35 r t $855	4 35 c $1 155			
Ford	Ford Motor Co Detroit, Mich	4 20 r $390 4 20 t $440	4 20 c $640 4 20 s $740				
Franklin	Franklin H H Mfg. Co, Syracuse N Y			6 30 r $1 900 6, 30 t $1 950	6 30 s $2 850	6 30, b $3 100	
Grant	Grant Motor Co Findlay O		6 22 t $795				
Great Western	Great Western Automobile Co, Peru Ind			6, 35 r t $1 185			
Haynes	Haynes Automobile Co Kokomo Ind			6 55 t $1 385 6 55 t $1 495			
H-C	H-C Motor Car Co Detroit Mich		4 28 r $600 4 28 t $650				
Herff Brooks	Herff Brooks Corp Indianapolis Ind		4 35 r t $885	6 50 r t $1 095			
Holly	Holly Motor Co Mt. Holly N J			6 60 r t $2,000			
Hudson	Hudson Motor Car Co. Detroit, Mich			6, 29, t $1 350			
Hupmobile	Hupp Motor Car Co, Detroit, Mich			4 23 r t $1,085 4, 23 c $1 165	4, 23 l $2 365		
Inter-State	Inter-State Motor Co Muncie Ind		4 35 r t $850 4 35 s $1 000				
Jackson	Jackson Automobile Co Jackson Mich		4 38 r t $985	4 40 r t $1 135 8, 70 t $1 685			
Jeffery	Thos B J Jeffery Co Kenosha Wis		4 40 r t, $1 000	4 40 t $1 035 6 50 t, $1,350			
King	King Motor Car Co Detroit Mich			8 45 r t, l $1 150 8 55 r t, l $1,350			
Kissel Kar	Kissel Motor Car Co Hartford Wis			4, 32 c $1,450 6 42 r t $1 485	6, 42 s $2 150 6 42, l $2 750		
Kline Kar	Kline Motor Car Co Richmond Va			6 36 r t $1 095			
Lewis-6	L P C Motor Co Racine Wis			6, 38, r t $1 390			
Lenox	Lenox Motor Car Co Boston Mass			6 50 t, $1,985 4, 40 r, t $2 000	6 50 r $2 250 6 60 t, $2 365		
Hollier	Lewis Spring & Axle Co. Jackson Mich		8 40 r t $985				
Lexington	Lexington Howard Co. Connersville Ind			4, 40 r t $1 375 6, 50 r t $1 875	6 60 r t $2 675		
Locomobile	Locomobile Co of America, Bridgeport Conn						6 43, t, $4 400 6 49, t, $5 100
H A L	H. A. Lozier Co Detroit Mich			12 40 r t l c $1 750			
McFarlan Six	McFarlan Motor Co. Connersville Ind				6 90 r t, $2 990		6, 90, l, $4,200
Madison	Madison Motors Co Anderson Ind		6 40 r $935	6, 40, t, $1,085			
Majestic	Majestic Motor Car Co, Chicago Ill			4, 30, r, t $1 075 6, 45 r t, $1 530			
Maxwell	Maxwell Motor Co, Inc. Detroit, Mich		4 25 r, $635 4 25 t, $6 5 4 25 c $865				
Mercer	Mercer Automobile Co Trenton, N J				4, 22, r, $2 750 4, 22, t, $3 000		
Mets	Mets Company Waltham Mass		4 25 r, t $600				
Mitchell	Mitchell-Lewis Motor Co Racine Wis			6, 48 r t, $1,250 8, 50, r, t, $1,450			
Moline	Moline Automobile Co East Moline Ill			4, 40, r t, $1 375	4, 50, r t $2 500	4, 50, l, $3 500	
Moon	Moon Motor Car Co St. Louis, Mo			6, 30 r, t, $1 195 6, 40, r, t, $1,475			
M P M	Mt. Pleasant Motor Co, Mt Pleasant, Mich			8 44, t, $1,085			
Marion	Mutual Motors Co Jackson Mich			6, 40, t, $1,090			
National	National Motor Vehicle Co. Indianapolis, Ind			6, 51, r t, $1,690 12, 70, r t, $1,990	6, 61, r t, $2,375		
New Era	New Era Engineering Co Joliet Ill		4 24, t $660				
Marmon	Nordyke & Marmon Co. Indianapolis, Ind				6, 34 r t $2,700 6, 34, l, $2,750		
Oakland	Oakland Motor Car Co Pontiac, Mich		6 32, r, t, $795	4, 38, r t, $1,050 8, 71 t, $1,585			
Oldsmobile	Olds Motor Works, Lansing Mich			4, 30, r, t, $1,095 8, 40, r, t, $1,295			
O-8	Owen-Schoeneck Co Chicago, Ill				6, 60, r, t, $2,250 6, 60, r, $2,800	6, 60, t, $3,100	
Packard	Packard Motor Car Co Detroit Mich				12, 90, r, t, $2,750	12, 90, t, l, $3,1[illegible]	
Paige	Paige-Detroit Motor Car Co Detroit, Mich			4, 36, r, t, $1,095 6, 46, t, l, $1,[illegible]	6, 46, l, $2,250		
Pathfinder	Pathfinder Co Indianapolis, Ind			6, 30, r, t, $1,595 12, 45, r, t, $1 975			

(Continued on page 34)


The Firestone Removable Rim Always Works
Proved by Many Years of Success in Hardest Service
A Firestone Factor of Efficient Truck Tire Service
which has proved its success wherever trucks are operated is the S.A E. Removable Rim Equipment Years of the hardest use in many varied lines have established the Firestone as standard equipment, always dependable
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TRUCK TIRES

American Gasoline Pleasure Car Manufacturers with Prices of Their Leading Models for 1916—Concluded

Name of Car	Name and Address of Manufacturer	Under $600	$600 to $1 000	$1,001 to $2,000	$2,001 to $3,000	$3,001 to $4,000	Over $4,000
Paterson	W A Paterson Co Flint, Mich		6 42, t $985	6 42, t $1,060			
Peerless	Peerless Motor Car Co Cleveland O			8, 80 r t $1 890		8, 80, l, $3,060	
Pierce-Arrow	Pierce-Arrow Motor Car Co Buffalo N Y						6, 38, r, t, l, $4,800 6, 48, r, t, l, $5,000 6, 66, r, t, l, $6,000
Pilgrim	Pilgrim Motor Car Co Detroit Mich		4 23 r t $685 4 23 c $835				
Pilot	Pilot Motor Car Co Richmond, Ind			6 45 r t $1 100 6 55 t $1,735	6, 75 t, $2,485		
Harvard	Pioneer Motor Car Co Troy N Y		4 24 r $750 4 24 c $850				
F R P	Finley Robertson Porter Co Port Jefferson N Y						4, 45, * $5,000
Premier	Premier Motor Mfg Co Indianapolis Ind				6, 38 r, t, $2,300		
Pullman	Pullman Motor Car Co York Pa		4 22 r t $740 4 22 c $990				
R-C H	R-C-H Corporation Detroit Mich		4, 25 t $850				
Regal	Regal Motor Car Co Detroit Mich		4 27 r t $650 4 39 r t $985	8, 44, r, t, $1 200			
Reo	Reo Motor Car Co Lansing Mich		4 35 r t $875	6, 45, r, t, $1,250			
Republic	Republic Motor Car Co Hamilton, O				6 43 r t, $2,950		
Ross Eight	Ross Automobile Co Detroit Mich			8, 34 t $1 350			
Saxon	Saxon Motor Co Detroit, Mich	4 18 r $395	6 34 r t $785				
Simplex	Simplex Automobile Co, New York City						6, 100, *, $5,000
Singer	Singer Motor Co Inc New York City					6, 50 r t, $3,200	6, 60, l, $4,500
Spaulding	Spaulding Mfg Co Grinnell Iowa		4 30 t $750	4, 50, r t, $1,250 4, 50, t, $1,300			
Sphinx	Sphinx Motor Car Co York Pa		4 28 t $640				
Standard	Standard Steel Car Co Pittsburgh Pa			8, 70, r, t, $1,735	8, 70 t, $2,100	8, 70 l $3,600	
Stearns-Knight	F B Stearns Co Cleveland O			4, 28, r, t, $1,395 4, 28 c, $1,900	8, 34, r, t, $2,050	8, 34, l, $3,350	
Steph	Stephens Company Chicago Ill	2 10 r $450					
Stewart	Stewart Motor Corp Buffalo N Y			6, 44, r, t, $1,950			
Studebaker	Studebaker Corp Detroit Mich		4 40 t $885 6 50 r $1 000	6, 50 t, $1 050	6 50 l, $2,250		
Stutz	Stutz Motor Car Co Indianapolis Ind				4, 36, r $2,100 4, 36, t, $2,300		
Thomas	E R. Thomas Motor Car Co Buffalo N Y					6 48, r, t, l, s, e, ‡	
Trumbull	Trumbull Motor Car Co Bridgeport Conn	4 14 r $395	4 14 c $500				
Velie	Velie Motor Vehicle Co Moline Ill			6, 40, t, $1 065 6, 45 t $1 400			
Richmond	Wayne Motor Works Richmond Ind		4 30 r t $885	6, 50 r, t, $1,095			
Westcott	Westcott Motor Car Co Richmond Ind			6 41, t, c $1,295 6 51 r, t, $1 595			
White	White Company Cleveland O				4, 30 r $2,650 4 30 t $2 700	4 45, t, $3,800 4, 30, s $4,000	4, 45, l, $5,200 4, 45, t, $5,300
Overland	Willys-Overland Co Toledo O	4, 25 r $595	4 35 t $750 4 35 l $950	6 45 t $1 145 4 40 l $1 750			
Winton	Winton Company Cleveland O				6 34, r t, $2,285.	6, 48, r t $3,500	6, 48, l, s, $4,750
Zimmerman	Zimmerman Mfg Co Auburn Ind			6 50 t, $1 495			

* Price for chassis only Bodies extra
‡ Prices on application.

Prices of Leading Electric Pleasure Cars for 1916

Name of Car	Name and Address of Manufacturer	Passenger Capacity, Body Type and Price		
		Under $2,500	$2,500 to $3 000	Over $3,000
Argo, Borland and Broc	American Electric Car Co, Saginaw Mich			
Detroit	Anderson Electric Car Co Detroit, Mich	3 p Cabriolet, $2,075 4 p Brougham, $2 175 5 p Brougham, $2,250		
Bailey	S. R. Bailey & Co Inc Amesbury Mass		2 p. Phaeton, $2,600 2 p. Roadster, $2,900 5 p. Brougham, $3 000	4 p Roadster $3,200
Baker	Baker R & L. Co Cleveland Ohio	4 p Coupe $2 475		
Rauch & Lang	Baker R. & L Co., Cleveland Ohio		2 p. Roadster, $2 600 4 p Brougham, $2,800	6 p. Town Car, $4,000
Columbian	Columbia Electric Vehicle Co. Detroit, Mich	2 p Runabout $950 3 p Coupelette, $1 250 4 p Brougham, $1 450		
100-Mile Fritchle	Fritchle Automobile & Battery Co Denver Colo	2 p Torpedo Roadster $2 400	2 p Cabriolet, $2 500 4 p Torpedo, $2 600	4 p Coupe, $3,200 5 p Brougham, $3 600
Hupp-Yeats	Hupp-Yeats Electric Car Co Detroit, Mich	4 p Coupe $1 500 4 p Coupe $2 000		
Ohio	Ohio Electric Car Co, Toledo, Ohio	4 p Coupe $2 400	4 p. Roadster $2 650 5 p. Brougham, $2 900	5 p. Brougham, $3,250
Chicago	Walker Vehicle Co Chicago Ill	4 p. Cabriolet, $1,965 5 p. Front Drive Limousine, $2 150		
Waverley	Waverley Company Indianapolis Ind	4 p Brougham, $2,000	4 p Brougham, $2 500 5 p Limousine, $2 500	
Woods	Woods Motor Vehicle Co. Chicago Ill		4 p. Brougham, $2,850 5 p. Brougham, $2,900	5 p Brougham, $3,100

Ready Reference Table of Commercial Vehicles for 1916

Leading Models of American Gasoline Motor Trucks and Delivery Wagons

Compiled by C Edward Palmer

THE motor truck has come to be such an important and indispensable adjunct to business that many commercial houses, both wholesale and retail, large and small, would be utterly lost if they were compelled suddenly to revert to the old-fashioned and slower method of transportation by means of the horse and wagon Many large business houses add to their motor truck equipment every year They buy a truck the same way that they engage a high-priced employee—not because they can get him at a certain figure but because of his capacity for business and his efficiency of operation Trucks are bought for their capacity and efficiency in the work they are to perform

To assist the prospective purchaser of a motor truck the following table has been arranged with the trucks grouped according to tons capacity In each column the first figure indicates the capacity in tons, and the second the horse-power rating of the motor Not every truck of each manufacturer is listed, but only the leading and representative models. The figures were compiled from data supplied by those manufacturers who responded to the request for this information

Name of Vehicle	Name and Address of Manufacturer	Tons Capacity Horse-Power and Price.					
		Under 1 Ton	1-1½	2-2½	3-4	5	6 and Over
Acme	Acme Motor Truck Co., Detroit Mich		1½, 25, $1,900	2, 27, $2,150	3, 34 $2,450 4, 34, $3,000.	5, 40, $3,800	
Adams	Adams Truck, Fdry & Mach. Co. Findlay, O		1 30 $1,850 1½, 35, $2,300	2, 25, $2,500			
Armleder	O. Armleder Co, Cincinnati, O			2, 40, $2,600 2½, 40, $2,800	3½, 47, $3,500		
Atterbury	Atterbury Motor Car Co Buffalo N Y		1 23, $1,800	2, 27, $2,400	3½, 32, $3 200		
Autocar	Autocar Company Ardmore, Pa.			2, 15, $1,650			
Auto-Truck	Auto-Truck Company, Bangor Pa		1 30 $1 400				
Available	Available Truck Co. Chicago Ill		1 30 $1,800	2, 40, $2,250	3½, 50, $3,000		
Avery	Avery Company Peoria, Ill			2, 36, $2,700	3, 36, $3,300	5, 45, $4,500	
Barker	C L. Barker Norwalk, Conn		1, 26, $1 600 1½, 26 $1,500	2, 20, $1,700			
Bessemer	Bessemer Motor Truck Co., Grove City Pa	¾, 25 $975	1, 25, $1,250 1½, 36, $1,600	2, 36, $2,000	3½, 43, $3,600.		
Blair	Blair Motor Truck Co., Newark, O			2, 30, $2,850	3, 35, $3,250 4, 43, $3,750	5, 45, $4,500	
Brockway	Brockway Motor Truck Co., Cortland, N Y	¾ 20, $1,300	1¼ 22, $1 600 1½, 22, $1,825	2, 27, $1,900 2, 27, $2,125			
Lambert	Buckeye Mfg. Co. Anderson, Ind	½ 25, $900 ¾, 25 $1 125	1 35 $1,500 1½ 40 $1,800	2, 40, $2,000.			
Buick	Buick Motor Co Flint, Mich		1 37, $1,150				
Burrows	Burrows Cycle Car Co, Ripley, N Y	½ 13 $375					
Chadwick	Chadwick Engineering Works, Pottstown, Pa	½ 16 $630					
Chase	Chase Motor Truck Co., Syracuse, N Y	¾, 25, $1,500	1, 25, $1,650	2, 30, $1,900	3½, 40, $3,300		
Brinton	Chester County Motor Co., Coatesville, Pa		1½, 30, $1,950	2½, 35, $2,250			
Little Giant	Chicago Pneumatic Tool Co Chicago, Ill	¾, 23, $1,500	1, 28, $1,350 1½ 28, $1 450	2, 27, $2,500.			
Coleman	Coleman Motor Truck Co. Ilion, N Y			2, 30, $2,400.	3, 40, $3,000		
Commerce	Commerce Motor Car Co. Detroit, Mich.	¾, 22, $875					
Continental	Continental Motor Truck Co., Chicago, Ill		1, 30, $1,550 1½, 40, $1,750	2, 40, $2,100.	3½, 45, $3,000	5, 50, $4,000	
Columbia	Columbia Motor Truck & Trailer Co., Pontiac, Mich.			2, 40, [illegible]			
Continental	Continental Truck Mfg Co Superior, Wis		1 25, $1,500	2, 30, $2,000	3, 35, $3,300	5, 40, $3,700	
Corbitt	Corbitt Automobile Co. Henderson, N C		1½, 26, [illegible]	[illegible]	3, 35, $3,700		

(Concluded on page 36)

Leading Models of American Gasoline Motor Trucks and Delivery Wagons—Concluded

Name of Vehicle	Name and Address of Manufacturer	Tons Capacity Horse-Power and Price: Under 1 Ton	1-1½	2-2½	3-4	5	6 and Over
Crawford	Crawford Automobile Co Hagerstown Md				3 40 $3 000		
Crown	Crown Commercial Car Co N Milwaukee Wis		1 30 $2 000	2 35 $2 500	3 40 $3 000		
Dart	Dart Motor Truck Co Waterloo Iowa	½ 20 $675 ¾ 30 $1 300	1½ 42 $1 800	2½ 42 $2 100			
Vixen	Davis Mfg Co Milwaukee Wis	½ 14 $395					
De Kalb	De Kalb Wagon Co De Kalb Ill		1½ 30 $1 950	2½ 40 $2 450			
Detroit	Detroit Commercial Car Co Detroit, Mich	¾ 17 $600					
Denby	Denby Motor Truck Co Detroit, Mich	¾ $890	1 $1 175	2 $1 985			
Horner	Detroit-Wyandotte Motor Co Wyandotte Mich		1 28 $2 000	2 32 $2 650	3 38 $3 200	5 45 $4 200	
Dispatch	Dispatch Motor Car Co Minneapolis Minn	¾ 30 $935					
Dorris	Dorris Motor Car Co, St Louis Mo	¾ 30 $1 000		2, 30, $2 500			
Doyle	James C Doyle San Francisco Cal		1½ 30 $1 750				
Vulcan	Driggs-Seabury Ord Corp Sharon, Pa			2 30 $2,750	3 30 $3 250	5 30 $4 500	
Duplex	Duplex Power Car Co Charlotte Mich			2 30 $2 800	3 40 $3,200		
Durable Dayton	Durable Dayton Truck Co Dayton O			2 36 $2 650	3½ 45 $3 400		7½ 60 $4 950
Fargo	Fargo Motor Car Co Chicago Ill	¾ 20 $950	1½ 23 $1 375	2 26 $1 575			
Federal	Federal Motor Truck Co, Detroit Mich		1½ 30 $1 800		3½ 40 $3 800		
Flexible Truck	Flexible Traction Motor Truck Co N Y City			2 30 $2 500	3 38 $2 800	5 38 $3 700	
Clintonville F W D	Four Wheel Drive Auto Co Clintonville Wis			2 29 $3 600	3 38 $4 000		6 44 $4 800
G V Mercedes	General Vehicle Co Long Island City N Y						6 25 $4,500
B A Gramm	Gramm Bernstein Co Lima O		1 28 $1 500	2½ 40 $2 600	3½ 48 $3 400		6 60 $4,300
Garford	Gramm Motor Truck Co Lima O		1 20 $1 450	2 29 $2 300	3 29 $3 400	5 36 $4 300	6 42 $4 500
Hahn	Hahn Motor Truck & Wagon Co Hamburg Pa	¾ 24 $1 100	1 30 $1 600	2 40 $2 000	3 40 $2 500		
Harvey	Harvey Motor Truck Works Harvey Ill			2 40 $1 975	3½ 40 $2 700	5 50 $3 400	
H-C	H-C Motor Car Co Detroit Mich	28 $550					
Henderson Bros	Henderson Bros Cambridge Mass	¾ 23 $1 100	1 27 $1 500				
Hendrickson	Hendrickson Motor Truck Co Chicago Ill		1 $1 700	2, $2 200			
Howard	Robert G Howard Boston Mass	¾ 25 $900					
Independent	Independent Motors Co Port Huron Mich	¾ 23 $1 285		2, 27 $1 800			
International	International Harvester Corp Chicago Ill	½ 27 $710					
Mack and Saurer	International Motor Co New York City		1 26 $2 000	2 26 $2 700	3 48 $3 400 4 48 $3 750	5 30 $4 800	6½ 30 $5 800
Jeffery	Thos B Jeffery Co Kenosha Wis			2 28 $2 750			
Kearns	Kearns Motor Truck Co, Beavertown Pa	½ 28 $785					
Kelly	Kelly-Springfield Motor Truck Co Springfield O		1½ 30 $2 000	2½ 30 $2 750	3½ 40 $3 400	5 40 $4 250	6 40 $4 500
King	A R King Mfg Co Kingston N Y				3½ 32 $2 600		
Kissel Kar	Kissel Motor Car Co Hartford Wis	½ 32 $900	1½ 36 $1 750	2 36 $2 100	4 50 $3 350		6 50 $4 350
Kleiber	Kleiber & Co Inc San Francisco, Cal		1½ 34 $2 250	2½ 24 $2,750	3½ 41 $3,300	5 52 $4 250	
Knickerbocker	Knickerbocker Motor Truck Mfg Co N Y City			2, 30 $2 200	3½ 40 $2 850		
Knox	Knox Motors Co Springfield Mass						Tractor 50 $4 500
Koehler	H J Koehler S Co Newark N J		1 35 $895				
Kopp	Kopp Motor Truck Co, Buffalo N Y	¾ 23			3½ 38		
Kosmath	Kosmath Co Detroit Mich	½ 22 $750					
Lange	Lange Motor Truck Co Pittsburgh Pa		1½ 30 $1 750	2½ 35 $2 350			
Hall	Lewis Hall Iron Works Detroit Mich				3½ 45 $2 800	5 45 $3 400	
Lincoln	Lincoln Motor Truck Co Detroit Mich	¾ 23 $900					
Locomobile	Locomobile Co of America Bridgeport Conn				3 29 $3 500 4 29 $3,650		
Longest	Longest Bros Co Louisville Ky				4 40 $4 000		
Maccar	Maccar Truck Co Scranton Pa		1 30 $2 100	2 40 $2 600	3½ 40 $3 250		
Mais	Mais Motor Truck Co Indianapolis Ind		1½ 35 $2 000	2 35 $2 800	3 45 $3 750		
Martin	Martin Carriage Works York Pa		1½ 35 $2 050	2 35 $2 150	3½ 45 $3 300		
Mercury	Mercury Mfg Co Chicago Ill	½ 15 $750			3 $1 580		10 35 $3 400 (Tractor)
Mogul	Mogul Motor Truck Co St. Louis Mo		1½ 23 $1 600	2 28 $2 000	3½ 34 $3 550		6 54 $3 800
Monarch	Monarch Light Truck Co Milwaukee Wis.	¼ 12 $350 ½ 25 $550					
Moon	Jos W Moon Buggy Co St Louis Mo		1½ 30 $1 600				
Moreland	Moreland Motor Truck Co Los Angeles Cal		1 23 $1 550	2½ 33 $2,400	4 36 $3 200		
Natco	National Motor Truck Co, Bay City Mich		1½ 20 $1 800				
Nevada	Nevada Truck & Tractor Co Nevada Iowa				3 40 $3 500		
Old Reliable	Old Reliable Motor Truck Co Chicago Ill		1½ 23 $1 950	2 36 $2 450	3 29 $3 250	5 42 $4 250	7 42 $4 500
Packard	Packard Motor Car Co Detroit Mich		1 26 $2 200	2 26 $2 800	3 32 $3 400	5	6
Palmer-Moore	Palmer Moore Co Syracuse N Y	¾ 25 $1 150	1 30 $1 350				
Menominee	D F Poyer Co Menominee Mich	¾ 23 $1 125	1½ 23 $1 575	2 27 $2 240			
Peerless	Peerless Motor Car Co Cleveland O				3 40 $3 700	5 40 $4 500	6 40 $5 000
Pierce Arrow	Pierce Arrow Motor Car Co Buffalo N Y			2 26 $3 000		5 38 $4 500	
Pull More	Pull More Motor Truck Co Detroit Mich		1½ 23 $1 600	2 23 $3 000	3 33 $2,600	5 33 $2 800	
Quakertown	Quakertown Auto Mfg Co Quakertown Pa	½ 35 $500					
Reo	Reo Motor Truck Co Lansing Mich	¾ 35 $1 075		2 35 $1 650			
Republic	Republic Motor Truck Co Alma Mich	20 $995	23 $1 275	27 $1 575	29 $2 350		
Robinson	Robinson Motor Truck Co Minneapolis Minn			2 27 $2 000	3½ 32 $2 800	5 32 $3 400	
Rome	Rome Motor Mfg Co Downingtown Pa		1 28 $2 450	2 32 $2 800	3 40 $3 400	5 48 $4 500	
Royal	Royal Motor Truck Co New York City				3½ 29 $3 500	5 36 $1 500	6 40 $4 800 7 50 $5 000
Rush	Rush Delivery Car Co Philadelphia Pa	½ 25 $625					
Sandow	Sandow Truck Co Chicago Ill		1½ 30 $1 700	2 35 $1 900	3 40 $2 450	5 45 $3 400	
Sanford	Sanford Motor Truck Co Syracuse N Y	¾ 25 $1 290	1 25 $1 470 1½ 30 $1 600	2 40 $1 910			
Schacht	C A Schacht Motor Truck Co Cincinnati O			2, 40 $2,800	3 40 $3 200		
Selden	Selden Motor Vehicle Co Rochester N Y		1 27 $1 700	2 25 $2 000 2 33 $2 250	3½ 33 $2 950		
Service	Service Motor Truck Co Wabash Ind		1 35 $1 375 1½ 40 $2 200	2 40 $2 500	3½ 45 $3 000	5 50 $4 000	
Siebert	Shop of Siebert Toledo Ohio		1 22 $1 350				
Signal	Signal Motor Truck Co Detroit Mich		1 23 $1 550 1½ 23 $1 750	2 27 $2 100	3½ 32 $3 000		
Sphinx	Sphinx Motor Car Co York Pa	½ 28 $675					
Standard	Standard Motor Truck Co Detroit Mich		1½ 30 $1 800	2 40 $2 000	3 45 $2 750 4 50, $3 025	5 50 $3 400	
Steele	W M Steele Worcester Mass			2 30 $2 250	3 40 $3 000	40 $4 000	
Stegeman	Stegeman Motor Car Co, Milwaukee Wis		1½ 35 $1 900	2½ 40 $2 500	3½ 50 $3 000	5 50 $4 000	
Sterling	Sterling Motor Truck Co Milwaukee Wis	¾ 22 $895		2 35 $2 800	3½ 45 $3 400	5 50 $4 500	7 60 $4 750
Stewart	Stewart Motor Corporation Buffalo N Y	¾ 30 $1 200	1½ 30 $1 390				
Studebaker	Studebaker Corporation Detroit Mich	¾ 10 $850					
Sullivan	Sullivan Motor Car Co Rochester N Y		1½ 30 $1 600	2 30 $2 250			
New York	Tegetmeier & Riepe Co New York City		1½ 30 $1 650				
Tiffin	Tiffin Wagon Co Tiffin Ohio	¾ 25 $1 300	1 25 $1 600	2 35 $2 400		5 45 $4 000	6 45 $4 300
Traboid	Traboid Truck Mfg Co Johnstown Pa		1 25 $1 250	2 40 $2 250			
Trumbull	Trumbull Motor Car Co Bridgeport Conn	¾ 19 $495					
United	United Motor Truck Co Grand Rapids Mich			2½ 27 $2 250	4 32 $2 900		6 40 $3 500
U S	United States Motor Truck Co Cincinnati O			2 27 $1 900	3 32 $2 100	5 32 $3 600	
Universal	Universal Service Co Detroit Mich		1½ 30 $1 950	2 40 $2 800	3 40 $3 400		
Veerac	Veerac Motor Co Anoka Minn		1 20 $1 000				
Viall	Viall Motor Car Co Chicago Ill		1½ 40 $2 250	2 30 $1 850	3 40 $2 250	5 50 $2 700	
Vim	Vim Motor Truck Co Philadelphia Pa	½ 20 $620					
Wade	Wade Commercial Car Co Holly Mich	½ 10 $300					
Walter	Walter Motor Truck Co New York City					5 45 $4 750	6, 45 $5 000 7½ 45 $5,250 12 45 $6 000
Netco	Walsh & Suthergreen Co Fitchburg Mass		1½ 30 $2 000	2 30 $2 250			
White	White Company Cleveland Ohio	¾ 30 $2 250	1½ 30 $3 150		3 30 $3 850	5 40 $4 700	
Wilcox Trux	H E Wilcox Motor Co Minneapolis Minn	¾ 28 $1 200	1 32 $1 600 1½ 45 $1 800	2 45 $2 000	3½ 45 $2 900		
Overland	Willys-Overland Co Toledo Ohio	¾ 35 $750					
Wisconsin	Wisconsin Motor Truck Works Baraboo Wis		1 25 $1 650	2 33 $2 275			
Witt Will	Witt Will Co Inc Washington D C		1 23 $1 650	2 28 $2 250	3 33 $2 750	5 36 $3 250	
Wichita	Wichita Falls Motor Co Wichita Falls Tex		1 17 $1 650	2 20 $2 100	3½ 20 $3 250		
Wilson	J C Wilson Co Detroit Mich			2 27 $2 000			

Price List of Leading Electric Commercial Vehicles for 1916

Name of Vehicle	Name and Address of Manufacturer	Tons Capacity and Price: Under 1 Ton	1-1½	2-2½	3-4	5	6 and Over
Detroit	Anderson Electric Car Co Detroit Mich			2 $3 100			
Baker	Baker R & L Co Cleveland O		1 $2 300	2 $2,800	3½ $3 500	5 $3 850	
C T	Commercial Truck Co of America Philadelphia Pa	½ $1 640	1 $2 095	2 $2 725	3½ $3 330	5 $3 935	
Connersville	Connersville Buggy Co Connersville Ind	¾ $750					
Couple Gear	Couple Gear Freight Wheel Co Grand Rapids Mich				3 $3 600* 3½ $4 400†	5 $5 000†	6, $4 000*
Ewbank	Ewbank Elec Transmission Co, Portland Ore	Prices on Application	Prices on Application				
100-Mile Fritchle	Fritchle Automobile & Battery Co Denver Colo		1 $1 750	2 $3 000	3, $4 500	5 $5 000	
G M C	General Motors Truck Co Pontiac Mich	½ $1 200	1 $1 300	2 $1 650	3½ $2 000	5 $2,350	6, $2 500
G V	General Vehicle Co Long Island City N Y	½ $1 700 ¾ $1 950‡	1 $2 100	2 $2 000	3½ $3 250	5 $3 700	
Piercy	Hub Motor Truck Co Columbus Ohio			2½ $2 500			
Lansden	Lansden Co Inc Brooklyn N Y	½ $1 175	1 $1 700	2 $2,100	3½ $2 475	5 $2 850	6 $3 200
Flec truck	Los Angeles Creamery Auto & Mach Co Los Ang Cal	¾ $2 800					
Walker Balance Drive	Walker Vehicle Co Chicago Ill	½	1	2	3 and 4	Prices on Application	Prices on Application.
Ward	Ward Motor Vehicle Co Mt Vernon N Y	¾ $875	1	2	3½	5 Prices on Application	Prices on Application.
Waverly	Waverly Company Indianapolis, Ind	½ $2 200	1 $2 635	2 $3,410	3½ $3,350	5, $4,625	

* Front Wheel Drive
† Four Wheel Drive.
‡ Worm Drive.

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INQUIRY COLUMN

READ THIS COLUMN CAREFULLY You will find inquiries for certain classes of articles numbered in consecutive order If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information There is no charge for this service *In every case it is necessary to give the number of the inquiry* Where manufacturers do not respond promptly the inquiry may be repeated

MUNN & CO *Inc*

Inquiry No 9412 Wanted the name and address of manufacturers of machines to make 2-color typewriter ribbons

Inquiry No 9450 Wanted the name and address of a manufacturer who can build a light simple motor for light automobiles and for portable farm work

Inquiry No 9451 Wanted the name and address of a manufacturer of machinery for making egg albumen

Inquiry No 9452 Wanted the name and address of a manufacturer making machinery for the production of Tannic Acid from the Mangrove plant

Inquiry No 9453 Wanted the name and address of a maker of a machine for washing and drying bristles, also machine for cutting combing and assorting bristles.

Inquiry No 9454 Wanted the name and address of a manufacturer of a machine for sewing the mouths of bags which will make a lug at each end in addition to sewing the mouth.

Inquiry No. 9455 Wanted the name and address of a manufacturer of equipment for making enamel cloth, rubber and drill cloth

Inquiry No 9456 Wanted the name and address of manufacturers of machinery for concentrating Thoria Nitrate from Monazite sand.

(*Concluded from page 30*)

changing from one speed to another with absolute precision and therefore avoiding numerous objections commonly found in change speed gearings, such, for instance as harsh chattering of the clutch mechanism and danger of breakage of the clutch elements due to contact when the several parts are operating at different speeds

APPARATUS FOR CONTROLLING FRICTION CLUTCHES A R HULTIN, care of John Nilson Bandon Ore Mr Hultin's invention relates generally to an apparatus for controlling friction clutches, and more particularly to an apparatus in which a non expansive fluid medium, such as oil, is utilized directly against a piston connected to the movable clutch member and is operated by an expansive fluid such as steam

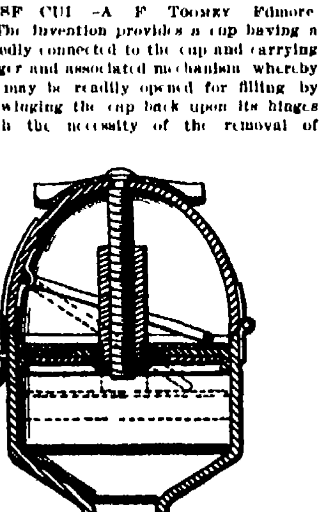
MECHANISM FOR CONVERTING RECIPROCATING MOTION TO ROTARY MOTION — S SYLVESTER Lisbon Falls Maine This invention has reference to machines for transmitting reciprocating motion into rotary and has for an object the provision of an improved simplified structure which may be readily reversed at any time so as to cause a rotary movement in either direction

GAGE FOR PRINTING PRESSES — J STIVERS Room 706 Claus Spreckels Bldg San Francisco Cal Among the principal objects which the present invention has in view are to facilitate increasing speed of operation of job printing presses to facilitate hand feeding incident to the employment of such presses and to reduce the manual labor commonly incident to feeding a press of the character mentioned

SHAPING MACHINE R F SMITH 18 Cherry St East Lynn Mass The inventor provides improvements in the art of shaping bodies whereby regularly or irregularly shaped holes or depressions are broached or produced or the exterior surfaces of the bodies are changed to a predetermined shape in a very simple and effective manner and without requiring automatic brakes or stops on the machine

CIRCULAR SAW GUARD—C F EVANS Weed Cal Among the objects of this invention are to provide an anti friction member on the guard which may be engaged by the lumber to be cut for pushing the guard below the table means for holding the guard yieldingly over the saw and means for shunting the cut off portions of the lumber from the saw

GREASE CUP —A F TOOMEY Fdmore N D The invention provides a cup having a cap hingedly connected to the cup and carrying the plunger and associated mechanism whereby the cup may be readily opened for filling by simply swinging the cap back upon its hinges and with the necessity of the removal of



GREASE CUP

any of the parts The cup has a cap on top to which a screw driven plunger is connected for reciprocation within the body of the cup, means being hingedly connected to the cut for preventing the rotation of the plunger or with the screw

MACHINE OR PRESS FOR MOLDING PLASTIC MATERIALS —L PENKALA 116 Rue Pierre Joigneaux Bois Colombes, Seine France This invention has reference to a press for molding plastic materials based on the known principle of the combination of a conoidal worm or screw with two gear wheels engaged in its convolutions for conveying the material while successively compressing its particles and bringing it to the mouth of the press to be molded in an almost dry condition

MACHINE FOR MOLDING PLASTIC MATERIALS — L PENKALA, 16 Rue Pierre Joigneaux Bois-Colombes, Seine France This invention relates to a drum press for molding plastic materials, based on the known principle of the combination of a screw with two cam wheels engaged in its convolutions for conveying the material, successively compressing its particles, and carrying it to the mouth of the press to be molded almost in a dry state

SPOOLING MACHINE.—F L. ATHERTON 17 Market St., Paterson, N J This invention provides a machine arranged to permit of running the quill or spool-carrying spindle at a high rate of speed to wind the thread on the quill or spool with a view to prevent the thread from sloughing when the quill or spool is used in a loom shuttle, to insure winding of the thread on the quill or spool with uniform tension and to automatically stop the spindle as soon as the quill or spool is filled with the desired amount of thread

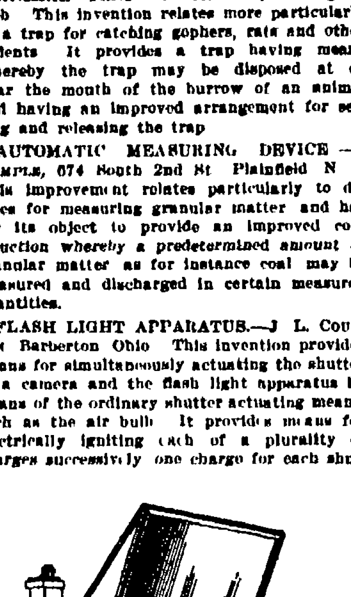
FLUSHING VALVE.—W NEMETHY, 444 Walnut St. Yonkers, N Y The object here is to provide a valve having a sleeve slidably mounted on a guide secured to a tank at an outlet therein, the guide affording communication between the tank and the outlet when the sleeve and the valve are raised against the resiliency of a spring connecting the sleeve with the guide

TARGET CARRIER —W N PICKETT, Box 534, Cashmere Wash. This inventor provides means for exposing a target in position for practice, delivering the same to the marksman, and returning a fresh target to practice position, without requiring the operator to expose himself to being shot or of the loss of time now necessary to carry a target from the practice position to the marksman, and to substitute a fresh target for the one removed.

ANIMAL TRAP —G M. FOX, Lexington, Neb This invention relates more particularly to a trap for catching gophers, rats and other rodents It provides a trap having means whereby the trap may be disposed at or near the mouth of the burrow of an animal and having an improved arrangement for setting and releasing the trap

AUTOMATIC MEASURING DEVICE —J TEMPLE, 674 South 2nd St Plainfield N J This improvement relates particularly to devices for measuring granular matter and has for its object to provide an improved construction whereby a predetermined amount of granular matter as for instance coal may be measured and discharged in certain measured quantities.

FLASH LIGHT APPARATUS.—J L. COURSON Barberton Ohio This invention provides means for simultaneously actuating the shutter of a camera and the flash light apparatus by means of the ordinary shutter actuating means such as the air bulb It provides means for electrically igniting each of a plurality of charges successively one charge for each shut



FLASH LIGHT APPARATUS

ter actuation and provides means electrically energized to carry an unexploded charge into ignition position after the previous charge has been ignited

ADJUSTABLE PARALLEL GAGE —B S THOMPSON, 844 Franklin St S E Grand Rapids Mich The invention relates to gages used by machinists pattern makers and other mechanics and provides an adjustable parallel gage for convenient use on planers, shapers, vises and other machines and tools for gaging the work in hand, and arranged to allow the mechanic to quickly and accurately adjust the gage to a desired height.

LUG STRAP FOR PICKER STICKS.—W H KELLY 1850 Perkiomen Ave., Reading, Pa This invention pertains to looms and provides a lug strap for picker sticks arranged to permit of convenient adjustment up or down on the stick for exerting more or less power to securely hold the lug strap in the adjusted position and to allow of fitting the lug strap on sticks of different width and without weakening the stick by holes, notches, and the like

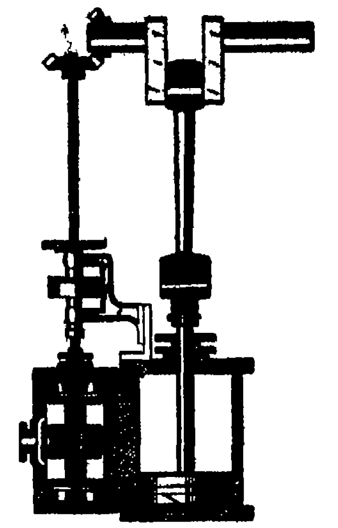
Prime Movers and Their Accessories

STEAM ENGINE.—G. E QUIGLEY, 121 W Chalmers Ave., Youngstown, Ohio. An object here is to provide a steam engine having a cylinder body which does not have to be cored, owing to the fact that passage-ways or ports are provided in separate port carriers. A further object is to provide an engine in which the coring of the cylinder saddle is obviated.

INTERNAL COMBUSTION ENGINE.—H. C. WELL, Room 1201, 110 W. 40th St., New York, N Y The improvement provides an engine with means to reduce the friction between a rotary valve sleeve and a reciprocating piston. It provides a ring to which the piston rod is articulated, the ring being rotatably disposed in an annular guideway at the inner side of the hollow piston.

ROTARY VALVE.—J FRANCO and R. ALONSO, P. O. Box 118, San Juan, Porto Rico. Their invention provides a rotary substitute for the present reciprocating valve now used in such engines; provides a separate valve for each end of the cylinder but revoluble with a shaft common to both; provides for compensation for the wear on either or both of the valves; and provides in each valve distinct inlet and exhaust passages adapted for alternate communication with the corresponding cylinder ports.

REVERSING GEAR.—J FRANCO AND R. ALONSO, P O. Box 118, San Juan, Porto Rico. This improvement relates to steam engines, particularly to engines provided with rotary valves for the steam inlet and exhaust, and the main object thereof is to provide means for reversing the engines. It provides means for



REVERSING GEAR.

reversing the engines while in operation. It accomplishes this by changing the relationship of the rotary valve with respect to the crank shaft of the engine. The invention also provides manual means for such reversing which are normally locked against movement.

INTERNAL COMBUSTION TURBINE.—G T DAVIS 30 R D No 1, Clinton, Mich The invention relates to improvements in devices for producing pressure by combustion, and provides a structure which will continuously produce pressure by internal combustion for use in operating a continuously moving turbine or other steam operated devices

ENGINE ATTACHMENT —C W SHEPARD AND H W PAYNE Box 424 Globe Ariz. This invention is an improvement in engine attachments and the invention has for its object to provide an attachment of the character specified adapted to utilize the pressure of the exhaust gases from an explosion engine, for generating electricity for lighting and starting

Railways and Their Accessories

AUTOMATIC RETAINING VALVE FOR AIR BRAKE SYSTEMS —E U MACK 327 E. Palmetto St Florence S C This invention provides a safety device which will automatically close the exhaust outlet from the triple valve when a full application of the brakes has been made and the air pressures equalize in the auxiliary reservoir and brake cylinder under each car of a train and thus retain the pressure in the brake cylinder while the auxiliary reservoir is being recharged with air from the main reservoir on the locomotive

LUBRICATING DEVICE.—O SWANSON Box 17, Atchee Colo This invention relates to lubricating devices designed especially for lubricating the flanges of the wheels of railway rolling stock. The device is characterized by a rolling member which supplies the flange of a wheel with lubricant while in frictional rolling contact therewith

RAILROAD SPIKE.—O WEISS, P O Box 740, Helena, Mont. This invention relates more particularly to an improvement in self locking spikes. An object is to provide a spike embodying improved means whereby the spike may be retained against accidental disengagement from a sleeper or after having been driven into the same.

Pertaining to Recreation

POOL TABLE POCKET LIGHT.—H JORGENSEN, Stanhope, Iowa. This invention has reference more particularly to luminous means to be associated with each pocket of the pool table It provides pocket lighting whereby any of the pockets occupied by a ball will be readily seen, as the light of the pocket engaged by a ball will burn until the ball is removed.

GAME APPARATUS —GERTRUDE E. MAGEE, 1925 Garden St., Hoboken, N. J The purpose here is to provide a game whereby to instruct children in the alphabet, in the compiling of small words, in numerals, etc., and also to enable children to quickly distinguish one letter from another and to name it, or numerals, or to recognize and locate short combinations of letters.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Development in Commercial Vehicle Design

(Concluded from page 17)

taken at both ends of the gear set. One shaft extends to the differential and drive gear assembly on the front axle, while the other transmits power to the drive gearing on the rear axle It will be seen that although the construction is more complicated owing to the greater number of parts used, than the conventional truck this is largely compensated for by the similarity between many of the power transmission units It is not necessary to carry as many repair parts in stock as would be needed to maintain a fleet of the simpler two-wheel drive trucks in which the front and rear axle assemblies are entirely different

The Tractor and Trailer Principle in the Ascendancy

There are certain transportation engineers who having carefully worked out hauling costs insist that the tractor and trailer principle is the cheapest method of *moving heavy loads* They advance the contention that the ordinary motor truck carries its load like a pack mule i.e. the motive power is applied through the rear wheels over which fully 80 per cent of the *paying load is placed* They *claim that* the ordinary motor truck is at a disadvantage in heavy hauling first because a large part of the motive power is lost since it is applied at the wrong point As is well *known a front* wheel drive can pull a heavy load over obstructions that cannot be surmounted by a rear wheel drive Second a motor truck empty is practically a vehicle without springs If *the springs are made heavy* enough to carry the heavy load they must be so stiff that they lack resiliency when the truck is operated without a load The power plant is subjected to more vibration because of this fact Third the ordinary motor truck not only supports its own weight but also that of the paying load on rubber tires When heavy loads are carried the tires depreciate rapidly Fourth the average motor truck representing a large initial investment must remain idle while being loaded and unloaded The truck cannot be easily converted from one purpose to another which means that in a business where many trucks are needed as in contracting a number of trucks are necessary to carry the widely diversified materials and tools used by these firms A motor truck fitted with a body suitable for carrying lumber cannot carry road metal economically nor can it be used to transport heavy building material such as structural iron or large stone slabs

The tractor illustrated is really a mechanical horse as it will move any load that can be pulled over the highway It supplies a front axle drive to the vehicle carrying the load By a special spring construction the tractor is carried by flexible springs which are resilient enough to fully protect the motor mechanism while at the same time the heavy load to be moved is supported by an independent pair of very heavy springs which are mounted under the turntable carrying the trailer and directly over the solid rear axle of the tractor By using a separate vehicle as a semi trailer 60 to 75 per cent of the paying load can be carried on steel tires reducing tire expense to a minimum Such a tractor need never be idle When there is loading or unloading to be done it is only the carrying vehicle which remains unoccupied The tractor is ready for attachment to any other vehicle as soon as one trailer is detached In fact the tractor can be used to haul two trailers if desired

Increased Braking Power for Motor Tractors

Another interesting feature of the tractor shown in the accompanying illustration is the use of hydraulic brake actuation means. When hauling a heavily loaded trailer it is apparent that great braking power is needed to stop both the tractor and load on a down grade of any consequence *If attempt were made to* brake the tractor by direct mechanical linkage, the operator would be forced to exert all his strength and even then he might not obtain the positive [illegible] necessary to bring the vehicle to [illegible] stop. With the aid of the hydraulic brake arrangement it is possible [illegible] operator to control the load without the expenditure of much effort. [illegible] hand operated brake lever is connected to the plunger of a pump which draws oil from a reservoir and forces it into a larger cylinder in which works the plunger operating the brake actuating *mechanism* Two of these brake actuators are used, one on each radius rod, each controlling one of the large hub brakes. Owing to the difference in size between the pump piston and the brake actuating *plunger a hydraulic ram effect* is secured. When it is desired to release the brake a movement of the hand lever forward after the retaining latch is lifted opens the by pass valve and permits the liquid *to flow out of the brake cylinder into* the reservoir The brake actuator is returned to the bottom of the cylinder by the brake releasing springs

The tractor principle is receiving wider application than formerly and *a variety* of these tractors are offered The one illustrated is a pioneer form and also incorporates a number of novel features that make it especially interesting and *representative of this coming form of in*dustrial transport.

The Knight-Type Sleeve-Valve Motor

(Concluded from page 19)

ing considerable side pressure, the cylinder wall (i.e. the inner sleeve) travels up with the piston thus reducing the friction On the explosion stroke, the piston carries a severe load, again exerting pressure on the cylinder wall and on this stroke the inner sleeve travels down with the piston

The exhaust valve is opened (40 deg before lower center) by the port in the inner sleeve coming down from behind the junk ring, the outer sleeve port registering to give full valve opening The closing of the exhaust valve is accomplished by the outer sleeve the upper edge of the port travelling down past the lower edge of the cylinder wall This closing is accomplished at 5 deg after top center completing the cycle of operations the intake valve opening 1½ deg after the closing of the exhaust

With the foregoing in mind, it will readily be seen that the inventor has accomplished more than his design originally contemplated for he has not only secured positively opened and closed valves, but has produced a motor in which the compression does not depend upon the seating of the valves, in which the valves are protected from the strains and stresses incident to explosion, and in which the friction of the piston against its retaining wall has been materially reduced

It is the aim of the internal combustion engine designer to secure, among other things first, a spherically shaped combustion chamber, and, second, an explosion point so located that the piston receives the full charge of the explosion immediately, eliminating the lag in the burning of the gas, which is always present if the spark plug points are not over the piston Reference to the illustration shows the egg shaped combustion chamber, and the location of the plug the latter being exactly in line with the center of the piston The cylinder head design also permits of easy machining, and hence there are no rough or high spots to gather carbon, and cause pre-ignition.

By use of this head, cooling is also rendered much easier, the water flowing freely around the submerged head, carrying off the excess heat, and cooling the spark plug, as well as the junk ring which, in turn, draws the heat from the inner sleeve The outer sleeve is cooled by the water flowing around the cylinder wall proper, the outer sleeve also transmitting the heat from the inner sleeve in the lower part of the cylinder

The oiling system of the sleeve-valve motor generally calls for force-feed through a drilled crank shaft to the connecting rod bearings. Earlier Knight motors were built with splash system, depending upon movable and adjustable troughs placed under each connecting rod

Latterly, however, this design has been dropped in favor of the one above referred to, an oscillating plunger pump eccentrically driven from the eccentric shaft by a continuation of the inner sleeve connecting rod of one of the cylinders delivering oil to the crank shaft bearings, drilled holes in the crank shaft registering with the oil holes in the crank shaft bearings and leading to the connecting rod bearings.

The surplus oil thrown off from the connecting rod bearings is broken up into a mist or spray which lodges on the bottoms of the sleeves and is carried up between them by their reciprocating action aided by grooves cut on the outside of each sleeve, which act as conveyors to lift the oil, and the suction present at the intake port. Holes drilled in the sleeves assist in distributing the oil evenly over all surfaces The thorough distribution of the lubricant between the sleeves, and between the outer sleeve and the cylinder wall proper greatly assists in so distributing the heat of the explosion that cooling is more uniform and thorough than is possible in any gas engine utilizing a stationary combustion chamber wall

To pass the oil up to the sections of the sleeves above the ports diagonal grooves are cut on the outside of each sleeve between the ports these grooves conveying the oil to the upper part of the sleeves and the travel of the sleeves distributing it The junk ring is lubricated by the action of the piston in depositing oil on the inner sleeve when the sleeve is practically at the bottom of its travel and the former is at top position at the conclusion of the exhaust stroke. Immediately after receiving this deposit of oil the sleeve travels upward, and deposits the lubricant on the junk ring

Seeing America and the Lincoln Highway

(*Concluded from page 13*)

mendous amount of improvement which has been achieved with the expenditure of the two and one half million dollars which have, according to careful estimates, been used for Lincoln Highway improvement during the two years since the announcement and dedication of the route The last time I drove this route I headed west by the compass, and the Lincoln Highway was only an idea in the minds of a few of us. This year I followed a line of red, white and blue markers straight through to the coast

I planned on reaching Cheyenne, Wyoming the seventh day out of Detroit but because of the fact that it rained every day for the first two weeks we did not get into Cheyenne until the evening of the twelfth day Every time it rains in the Middle West thousands of dollars worth of road work is wiped out to be done over again by the people when the first fair days arrive But the people are beginning to realize that the dirt roads, which require almost complete reconstruction after every rain, are really the most expensive roads they could have requiring the expenditure of thousands of dollars a mile every year in maintenance and in hauling costs, three fourths of which could be saved by hard-surfaced roads.

I encountered gangs laying concrete roads on the Lincoln Highway in Indiana at midnight under the light of arc lamps and across this state as in Iowa and Nebraska the driver is almost given the impression that he is traversing what will be a railroad grade For steam shovel work is noticed mile after mile across all of these states. The hills are being cut off and dumped into the valleys. Oftentimes the cuts are 30 feet deep, as near Marshalltown, Iowa, and the fills nearly as deep. All this work is preliminary to permanent hard-surfacing. But for all the improvement, the Lincoln Highway is as yet nearly all natural road from the Mississippi River to the California line. Yet the effort which is expended upon keeping the Highway in perfect shape is so great that it can be said now that the Lincoln Highway trip in dry weather would present almost no difficulties.

One cannot consider a [illegible] drive without touching upon [illegible] most interesting features, and which [illegible] up for all the discomforts of [illegible] —the diversity and beauty [illegible] ery The fair farming country [illegible] ana, Illinois, Iowa and Nebraska, [illegible] a constantly varying picture of [illegible] peace and plenty. The green [illegible] rolling hills of the Middle West [illegible] one gradually from the Mississippi [illegible] to the national divide at the [illegible] the Rockies by a hardly perce[illegible] which rises some 8,000 feet in [illegible]

A Ruskin or a Whistler is required to fitly portray the wondrous beauty of [illegible] drive around Lake Tahoe, [illegible] jewel of lakes that lies on the border between Nevada and California. Fed by a hundred tinkling crystal streams of [illegible] water which flow from the eternal snows of its encircling peaks, surrounded [illegible] mighty forests of virgin fir and pine, it lies in the bottomless crater of some [illegible] historic volcano its pellucid depths [illegible] Mediterranean blue reflecting the fleecy California clouds. I have driven a great deal in many parts of the globe, and I have seen most of the famous beauty spots of both the old and the new world, but I have yet to experience a sight more wonderful or a drive more inspiring than this trip over the Lincoln Highway around Lake Tahoe California roads are in the main perfect The Lincoln Highway from Reno west is in really wonderful condition

The troubles of the transcontinental tourist are over when he reaches Reno, in the Truckee Valley itself one of the world's beauty spots. The crying shame is that there should be any troubles at all in the path of the motorists attempting to reach this wonderland of nature The crying need is for a hard surfaced, perfect road leading from the Statue of Liberty to the Pacific shores, allowing those thousands and hundreds of thousands of eastern car owners to start for California with an assurance of perfect comfort every foot of the way The West needs these people it needs their money They need the West, and it is a realization of these facts that is lending such force to our efforts in improving the Lincoln Highway

But the great West is helpless to help itself I stopped in Reno and had a talk with Frank Byington the mayor He expressed conditions when he said "We want the tourist we want good roads, but Nevada has 425 miles of Lincoln Highway between its borders an area of 110,000 square miles and a population of less than eighty thousand. What can we do?" The same thing is true of Utah, Wyoming, and to a lesser extent in Nebraska Every effort is being strained to put the Lincoln Highway in the best possible condition. To-day there is but one really bad spot on the road across Nevada, and that is a matter of twenty miles near Fallon, which $50 000 would remedy But when you speak of hard surfaced roads across the West you are speaking in sums of money which by no possibility could be raised in the West. The question is a *national* problem, the *country* must coöperate to put through our main routes The Lincoln Highway Association offers a medium for this coöperation.

If you drive across the Lincoln Highway this year, or next year you will get some impression of the magnitude of the problem which the Lincoln Highway Association has before it. It is one of the greatest problems which face the country to-day It is a problem of greater interest by far to the majority of our people than any question of tariff or international relations. The building of the Lincoln Highway is a problem of vital interest to sixty million Americans. If all of them could be made to realize it and give it their aid and support, as the people directly on the route are doing, it could be completed next year.

The conception of a transcontinental boulevard is two years old. To-day it is well marked from ocean to ocean and is a pleasant drive in fair weather every foot of the way. That is a great deal. But we must eliminate that fair weather [illegible]. With the [illegible] of all [illegible]

Americans we will, and "Seeing America" in a motor car ten, or even five, years from now will not be an exploit for the adventurous, but an everyday trip of interest and enjoyment to millions.

Development of the American Motor Car That Has Led Up to the V-Type Multi-Cylinder Motor

(*Concluded from page 26*)

is a well defined point beyond which it is not possible to carry the intensity of each explosion without making the motor very rough It was clearly demonstrated that it would be necessary to use more cylinders of small diameter rather than to increase the size of the four cylinders and the six cylinder motor was the out come.

Fig 4 shows the six cylinder engine in which, practically speaking secondary vibration and the rocking couple are eliminated. The increase in the number of cylinders also causes the impulses to over lap and thus practically eliminates dead centers. In consequence this motor can be made to pull steadily at a much slower speed than the four The slight added complication which many conscientious motor car builders had sought to avoid was readily accepted by the public because the new construction gave an important result previously unobtainable

An important improvement which was consummated during the era of the six cylinder motor was the addition of an electric generator and an electric starting motor

For a long time the results obtained from the six cylinder motor seemed to satisfy the public completely but the public was becoming more critical each year and began to come back with the same old demands asking for more range of ability, greater smoothness and less noise As in the case of the four cylinder an attempt was made to give more range of ability by either making the motor larger, or by running it faster and while the six cylinder motor due to its inherent ly perfect balance can be run at higher speeds than the four with a reasonable degree of smoothness, still it was found that there is a definite point beyond which it is not possible to increase the size of the cylinders or the speed of the motor without running into roughness It was therefore determined that it would be necessary to add more cylinders and make them smaller, and the eight cylinder or twin four V type motor was developed

The First of the Twin Type

Fig 5 shows the twin four V type motor This motor has a better overlap of impulses than the six cylinder motor and consequently more nearly constant torque

For a given total size of motor the twin four motor will of course have smaller cylinders than the single six and each individual impulse is therefore smaller with the result that the character of the torque is improved not only because the explosions come closer together—that is four per crankshaft revolution instead of three—but also because each individual impulse is less intense and therefore, has less tendency to produce harshness

The principal objection to the twin four type of motor is the fact that it contains the four cylinder principle and is therefore, subject to secondary vibration but this is considerably less than it would be in a single four, but as it is desirable to run multi-cylinder motors at higher speed in order to obtain the greatest range of ability, the secondary vibration becomes objectionable on account of the fact that it builds up in proportion to the square of the speed The search for further refinement was, therefore insistently pressed, and resulted in the designing of the twin six or twelve cylinder V type motor

The Latest Development

Fig. 6 shows the twin six motor, which combines the perfect balance of the six cylinder motor with the greatest continuity of torque thus far obtained. In this motor small aluminum alloy pistons, carefully designed bearings, combined with a perfect lubrication system and careful workmanship make possible a higher speed than has ever before been

obtained except with special racing motors On the other hand, the continuity of torque enables cars equipped with this type of motor to be driven at a mere crawl

The extreme reliability of modern valve mechanism and spark plugs minimises the objection to the additional number of these parts which are required in this type of motor

It is my opinion that in the twin six motor we have reached the practical limit in the number of cylinders, as in this motor we obtain practically uniform torque and plenty of power without making each individual impulse of sufficient magnitude to be objectionable One reason for this statement is the fact that in order to get a perfectly balanced unit, the next step would either have to be 18 or 24 cylinders

The Automobile of 1916

(Concluded from page 11)

change speed gearing The brake rod arrangement has been simplified in many cases, to reduce a number of supports or connecting links. The foot brake and clutch pedals and even the steering gear are being attached to the power plant instead of to separate points on the frame and there is also a general decrease in weight and increase in strength by the use of steel stampings and drop forgings for parts that were formerly cast of malleable iron The use of center control which is a logical change has met with considerable favor Instead of the old gear shift lever arrangement at the side of the frame the use of the unit power plant has made it possible to attach the change speed gearing shift lever and emergency brake actuator directly to the gear box cover thus eliminating the outboard supporting bracket and telescopic control pipe and rod arrangement that was formerly used

Another point making for simpler chassis construction is the use of the Hotchkiss drive With this system the braking and driving torque is taken through the rear springs which means that all radius rods torque members or distance rods have been completely eliminated This reduces the number of points of a depreciating nature and results in a quieter operating chassis Several cars are adopting a recently developed form of differential gear in which the compensating action is obtained through worm gearing instead of the usual spur or bevel gear arrangement This form is said to provide traction to the wheel having the greatest resistance instead of to that having the least resistance, as is done by the more conventional spur or bevel pinion forms

The body construction is not only of more graceful appearance but bodies are larger, more comfortable, and in many cases even lighter than the designs they displace Another development is the use of adjustable parlor car types of seats in the higher grade cars One improvement that is sure to be appreciated by the motorist is the detachable coupe or limousine top which can be used to convert the usual form of open roadster or touring car to a more comfortable vehicle well adapted for winter service Other changes in body design are the use of close coupled three- and four passenger bodies of the three- and four leaf clover seat arrangements. The seats of most runabouts are now being made wide enough to carry three people

Easier Riding Qualities as the Result of Improved Spring Suspension

In the matter of spring suspension the chassis has been improved greatly for the coming season The cantilever type of spring is becoming very popular, but it has not captured the entire field, because many of the most easy riding cars are equipped with semi-eliptic and three-quarter eliptic springs, having an especially long lower member supported under the axle instead of attached to the top of that member. The underslung frame, which was featured by a number of makes of cars in years past, has been entirely eliminated from the market.

Predictions were freely made last year that wire wheels would be universally used, and that the day of the [illegible] wheel [illegible] cally all [illegible] furnish wooden [illegible] tional artillery type on [illegible] though wire wheels m[illegible] an option in many ca[illegible] extra sum for the car [illegible]

There has been pra[illegible] in the rim equipment, [illegible] tachable demountable [illegible] practically all types o[illegible] renewed interest, howe[illegible] type of tire, owing to [illegible] iency, fuel economy, [illegible] claimed by the protagon[illegible] of construction The cor[illegible] by any means as it was [illegible] forms of pneumatic tires [illegible] in connection with the bi[illegible] tire the carcass is composed [illegible] ment of cords looped arou[illegible] members at the base of the [illegible] vulcanized side by side in[illegible] usual fabric layers

Many motorists expected to find the electrical gear shift a feature of many of the 1916 automobiles on ac[illegible] of the wide use made of electric current in the modern motor car The hand-operated gear shifting lever still reigns supreme, however though the electric gear shift is offered as optional equipment in a number of cases

Electric Starting and Lighting Systems

(Concluded from page 2[illegible])

that is one quarter discharged and which shows a specific gravity of 1.200 will not freeze at temperatures exceeding 60 degrees below zero

When 5-32 candle power lamps are used in the lamp bank it means that 5 amperes will flow through the battery If the battery is completely discharged and it is a 100 ampere hour type, it will take approximately 24 hours to charge it completely

When alternating current only is used for the lighting mains it is necessary to interpose a rectifier between the line wire and the storage battery Simple rectifiers that may be connected to any lamp socket may be obtained at relatively small cost from dealers in electrical appliances During the winter season it is well to remember that a storage battery is only about 50 per cent as efficient as during warm weather and the lamps should only be used when necessary and no current wasted in useless engine starting A depleted storage battery always shows when it is discharged by causing the lamps to burn dimly or supplying so little current that the starting motor will barely turn the engine crankshaft over

Inspection and Care of the Dynamo and Motor

The manufacturers of starting and lighting systems have made every effort to have the various units function as nearly automatically as possible. At the same time some attention will be needed by the other parts of the system though these do not need the periodic inspection that must be given the storage battery The dynamo should be looked over and any carbon dust that has been worn away from the brushes due to the abrading action of the commutator and which has fallen to the lower portion of the commutator compartment should be blown out with compressed air because a considerable accumulation of this material, which is a conductor of electricity, may allow a leakage of current to the ground or produce a short circuit between the brush carrier and the generator casing. A blackened or rough commutator must be smoothed down with fine sand paper while the armature is rotating The makers give positive instructions that emery cloth should not be used for this purpose. After the commutator has been smoothed, all particles of metal should be removed from the insulation between the copper segments and care should be taken that this insulating material does not project higher than the surfaces of the segments. Any projections should be filed down to a lower level than that of the copper members upon which the brushes bear.

The brushes must not only make perfect mechanical contact with the commutator but [illegible] electrical

connection with it. Oil or grease on the brush assembly or segments should be removed and it is well to make sure that there is sufficient spring tension to keep the brushes in positive contact with the commutator At the same time, the spring tension should not be excessive because too much spring pressure will cause untimely deterioration of the brushes and will also tend to heat the commutator The starting motor is subject to the same electrical troubles as the generator Defects in either the motor or dynamo driving mechanism are of a purely mechanical nature and can be easily corrected by any mechanic The centrifugal governors used on a number of the generators applied to cars several years old are not apt to give trouble unless parts become broken or the action becomes clogged with gummed oil or grease Any oil between the clutch faces will prevent proper frictional adhesion, while broken links or springs in the governor mechanism will disturb the continuity of the drive

Lamp Troubles and Their Causes

All wiring should be protected from the possibility of becoming covered with grease, oil or water and in all cases the regular insulation should be supplemented by a conduit or insulating material or a substantial armor All connections should be gone over to make sure that these are tight If a fuse is blown or if the protective circuit breaker operates this indicates a "short-circuit between one of the current conveying wires and the metal frame of the car A short circuit is often indicated by the action of the amperemeter If the pointer vibrates on the discharge side it shows that there is a path for the passage of current between one of the wires leading to the lamps or other current consuming units and the frame If the lamps do not functuate properly trouble may be looked for in the wiring or in defective lamps

In many lighting systems the dash and tail lights are wired in series and if one of these goes out it will produce a break in the circuit and automatically make the other go out also

Lamp troubles may be usually laid to defective wiring "grounds loose contacts defective fuses and switches Dim lights indicate a rundown storage battery

The user of an electric starting and lighting system will avoid trouble by observation of the few simple rules which follow and which have been formulated by a prominent manufacturer of these systems

First Always be sure that the battery is properly charged and that all connections throughout the system are clean and firm Second If the generator is suspected the only point liable to be at fault is the brush contact at the commutator or accumulations of oil and grease on the commutator Short circuited armature or field windings are extremely rare Do not replace worn out dynamo or starting motor brushes with any other than those supplied by the manufacturer and be sure that the brushes are properly fitted to the commutator Never put oil or grease on the commutator of the generator or starting motor as this is a point that requires no lubrication Never turn the hose on the generator starting motor or any of the regulating devices when washing the car Third Inspect the generator driving means from time to time If a silent chain is used don t tighten up the chain unless the slack becomes excessive from wearing of the link rivets It is necessary to operate a silent chain reasonably loose to prevent noise and wear The silent chain drive, if exposed must be cleaned at frequent intervals and lubricated Fourth Never run the car if for any reason the battery is disconnected, unless the chain driving the generator or the generator itself has been removed Never attempt to propel a car with a starter Such ' stunts are possible but expensive! Do not attempt to make any adjustments of any kind in the circuit breaker, regulating relays or dynamo-output governors Always have this work done by a competent mechanic familiar with the system. Never fuss with the system when it is operating properly

Father Time the Only Official Tester

(*Concluded from page 24*)

automobiles, and it was his decision that put two-cycles on the scrap heap to keep company with steamers Thus two marvelous types of cars—and they were marvelous types—passed out of use. Their merits could not save them from the discard.

The lesson is simply this No type of motor can stay on the market unless it

has two cardinal points of value, namely:

1 Positive merit.

2 Absence of demerits, defects, drawbacks, disadvantages

The two points are not similar

The rejected two-cycle had twice as many power strokes as were found in the accepted and triumphant four cycle. That was the two-cycle's positive merit

But also, as owners came to learn, the two-cycle was freakish in performance and could not be depended upon It was not free from defects Therefore, it was forced to pass out of the market

So with the steamer All the claims made for the steamer in the paragraph at the head of this article were true, unquestionably true The steamer was wonderful in positive merits But, when owners of steam cars eventually weighed the steamer's merits against its demerits the verdict was "guilty,' and the steamer—once overwhelmingly the most popular car in America—fell into general disuse

These two striking cases, distinctly separate yet remarkably alike, are not the only ones that could be cited I have seen many "wonders" come and go And as each new idea is put forward in the automobile industry, I seek to determine first of all, what are its weaknesses, and, next, whether its weaknesses can be cured For incurable weaknesses mean inevitable defeat no merit is ever great enough to offset glaring faults

The Heavens in January

(*Concluded from page 28*)

Taylor's Comet

A comet, visible in a small telescope, was discovered by Taylor at the Cape of Good Hope at the beginning of December, close to Delta Orionis It was moving slowly northward and westward Provisional elements of its orbit, computed at the University of California show that it had just passed perihelion (on November 4th) at the unusually large distance of 223,000,000 miles from the sun Its orbit is inclined 17° to the plane of the ecliptic, and its motion is in the same direction as the earth's but a little slower It will, therefore, remain visible for several months, but slowly recede from the earth and sun and grow fainter Its predicted position on December 24th (the last date given in the published ephemeris) is 5h 12m 17s R A 3 56′ north declination Its motion is northeasterly, and almost uniform, at the rate of 18s of R A and 14′ of declination per day, which would put it on January 1st in about 5h 8m + 6° about 3° east and a little south of γ Orionis

Princeton University Observatory December 20th, 1915

Death of James M. Dodge

On December 4th 1915 James Mapes Dodge, an inventor of mechanical devices more particularly conveyors and power transmission systems, died at his home in Philadelphia

Mr Dodge was born on June 30th 1852 at Waverly, N J His grandfather was Prof James J Mapes, a noted chemist and scientist and his mother Mary Mapes Dodge a noted author for many years editor of the "St Nicholas Magazine"

It is probably to the widely diversified experience gained in earlier years that Mr Dodge owed his great business success of later years After leaving college he worked a short while in an iron works leaving later to enter the employment of John Roach, the shipbuilder, at Chester, Pa Here he rapidly advanced to the positions of journeyman, foreman and superintendent of erection Shortly after the Centennial at Philadelphia in 1876, he left the shipyard and after several years of experience in the East went to Chicago There he formed the acquaintance of William D Ewart, the inventor of the Ewart link belting and later became associated with Mr Ewart in the development of the chain business

The remarkable development of chain drive and conveying and elevating appliances is too well known to be described in detail, suffice it to state that Mr Dodge's later career was prominently identified with it. It was in 1880 that he developed a system of sto[illegible] coal in large conical piles an[illegible] it by machinery, which is stil[illegible] rival to-day His invention[illegible] the construction and manufac[illegible] chain are as important [illegible] numerous.

Mr Dodge possessed that [illegible] tion of talents, inventive [illegible] executive ability of the highe[illegible] was a staunch advocate of [illegible] among employees and thoug[illegible] years a large employer of me[illegible] that he never met with stri[illegible] labor troubles. He was a [illegible] leader in the general introduc[illegible] of scientific management with the d[illegible] purpose of greater efficiency in the work and more pay, shorter hours and better working conditions for his men At the time of his death he was identified with a number of prominent clubs, technical societies and institutions.

Motor Truck Notes

T N A writes 'We have fo[illegible] by experience that the pneumatic tires [illegible] 1,500-pound delivery cars give far [illegible] service if they are kept inflated to their proper pressure We cannot get o[illegible] men to test the pressure every day, however, and we would like to know if there is any method by which we could connect the valve with the ignition system so that a soft tire would stop the motor until the driver dismounted and either changed the tire or pumped it to its proper point."

A Your plan would hardly be practicable although it would certainly serve to remind the men to keep the tires well inflated The same results could be obtained, however, by the use of one of the ingenious devices known as a 'tire signal This is to be attached to each valve in the place of the dust cap and is previously set to any pressure below the normal that is desired For example, if a 4 inch tire should be inflated to 80 pounds per square inch, the signal could be set to give its warning at 70 pounds per square inch of air pressure This setting cannot be made by the driver, and therefore he is compelled either to drive his car with the tires properly inflated, or to be annoyed and made conspicuous by the continuous shrill warning note of the signal, which cannot be turned off until it is removed from the tire

W C O writes 'Our County Supervisors have decided to treat our main highways with hot tar Are any trucks provided with mechanical sprinkling devices for this purpose?"

A Some truck companies have designed special tank bodies that are provided with an air compressor operated from the transmission of the car This air compressor forces the hot tar out through openings, in the form of a spray, so that the material is sprinkled evenly over the entire surface, and none is wasted. A built in steam generator is also included in the outfit, for the purpose of keeping the tar in a fluid state. This is accomplished by means of coils of pipes in the tank, through which the steam passes. It might be well to suggest that, if the sprinkler truck is to be used in restricted territories, it would be advisable to provide it with steel wires that would also serve partially to roll the road. Tar, grease, or gasoline is very destructive to rubber, and naturally a truck used for tar sprinkling would have occasion to travel almost continuously over freshly-oiled roads. If, however, the territory over which the sprinkler would do its work is a large one, it must be remembered that steel tires will not allow the vehicle to travel as fast as would those of the conventional type.

D W C writes The engine used on one of our light trucks heats up unduly. We have had the carbon cleaned out, the carburetor adjusted, and know the lubrication system is working all right. Our steam engineer advises that we clean out the cylinder water jacket and radiator spaces with boiler compound, as the water we use deposits solid matter and the boiler compound is absolutely necessary in connection with our stationary steam engine power plant. Would boiler com-

pound dissolve the scale and sediment in the water spaces?

A. We advise caution when using boiler compounds in cleaning out automobile cooling systems. Some of these are very harsh in action and contain acids that cannot fail to injure the delicate construction of the radiator, which uses very thin tubes. Find out what the boiler compound consists of before using it A compound that would be entirely practical in a large steam boiler with tubes and shell varying from ¼ inch to ⅜ inch thick might easily eat through the thin radiator tubes, which are no thicker than heavy paper A large number of scale dissolvers are offered for cleaning out automobile cooling systems all of these being guaranteed to do no harm to radiators Consult a local chemist to find out what foreign matter the water you use contains and he will undoubtedly recommend some chemical to neutralize the foreign matter A good way to clean out sediment is to run a stream of city water under pressure through the cooling system for a few minutes This will remove almost all loose sediment The heat is not great enough in a radiator to produce a hard scale such as forms in a steam boiler so a compound strong enough to cut this would probably injure the automobile cooling system You will prevent all future trouble from your cooling system if you set out a rain barrel and use this water distilled by nature in the radiator The only sediment then resulting would be the rust from the water jacket interior which is unavoidable Be sure the fan belt is tight and circulating pump functioning properly The impeller in the water pump sometimes sticks and shears off its driving key or it may wear enough to reduce the flow of water Your overheating trouble may be due to either of these causes

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Legal Notes

Holding as to Patentable Novelty — In Miehle Printing Press & Mfg Co v Whitlock Printing Press & Mfg Co Judge Lacombe in the course of his decision said, ' Patentable novelty is sometimes found in discovering what is the difficulty with an existing structure and what change in its elements will correct the difficulty even though the means for introducing that element into the combination are old and their adaptation to the new purpose involves no patentable novelty "

Patent Decision — A recent issue of the Patent Office Gazette contains a report of three commissioners' decisions in ex parte cases all involving the question of patentability and particularly interesting because one case was decided by Commissioner Ewing himself, the second by First Assistant Commissioner Newton and the third by Assistant Commissioner Whitehead In all three cases some claims held unpatentable by the Board of Examiners in Chief were decided to be patentable by the commissioner of his assistants on appeal One case was that of Ex parte Whitelaw the invention being an engine and in deciding the case Mr Ewing held that a construction in certain of the claims involved a reorganization not suggested by the patents cited and allowed the claims

In the case decided by Mr Newton, *that of Nelson & Nelson,* metallic packing, the assistant commissioner held that the references could not be held to disclose the split ring of spring metal provided with a seat of less diameter than the normal diameter of the ring and, furthermore the mode of providing the result is different in applicant s device from that in either of the references

The case decided by Mr Whitehead was Ex parte Klenk and in holding two claims patentable the assistant commissioner said the claims specified "that the springs by which the latch is held in place are so arranged that they provide a stop for limiting the movement of the latch in an unlocking direction This construction is not suggested by any of the references and the claims are deemed allowable."

NEW BOOKS, ETC.

THE AEROPLANE. By Claude Grahame-White and Harry Harper New York Frederick A Stokes Company 8vo, 280 pp, illustrated.

THE MAN OF WAR. What She Has Done, and What She Is Doing By Commander E Hamilton Currey, R N (Retired) New York Frederick A Stokes Company 8vo, 297 pp, illustrated. Price, $1 50 net

The Romance of Reality series aims at combining sound science with fascinating reading In 'The Aeroplane' is sketched the history of human flight from such crude efforts as those of Simon the magician to the present use of aircraft in sport and in war As an English work, it perhaps over-emphasizes Cayley Henson, and Stringfellow but it will do our general reader no harm to know a little more of the truly prophetic work of this trio Speaking of prophecy the authors assure their countrymen that in less than twenty years the Londoner will be spending his week-ends in New York crossing in twenty hours by means of luxurious vibrationless aero liners of enormous size In Commander Currey's The Man-of War we again find popular history and present achievement pleasingly combined From the galley of the 16th century to the torpedo craft of to-day text and pictures make clear to us the construction armament and handling of the fighting ship

WIRELESS TIME SIGNALS Translated from the French official handbook *Réception des Signaux Radio télégraphiques par la Tour Eiffel* London E & F N Spon Ltd 8vo 133 pages 30 illustrations and one folding plate Price, $1 25 net

The high order of importance attained by radio time signals and weather bulletins renders most opportune the appearance of the work entitled Wireless Time Signals It is not an original work but a translation from the French official handbook *Réception des Signaux Radio télégraphiques par la Tour Eiffel* to which the translators have added several original appendices

A minor portion of the work is devoted to descriptions of apparatus suitable for the reception of time signals from long distance stations especially the Eiffel Tower plant at Paris Modern amateur practice is much in evidence in the apparatus and circuits described

The bulk of the book deals with the subject of time signals and contains much information of great interest particularly to those desirous of comparing chronometers with the time signals with the minimum of error

STEAM POWER By W F Dalby F R S New York Longmans Green and Co 1915 8vo 760 pp with 250 diagrams Price $6 net

Steam Power is broadly conceived and executed The scientific principles of the subject are first approached by way of the objective realities of a steam plant this parallels the method of mastering a foreign tongue by starting with actual conversation leaving the grammar and construction for later consideration Once the student has mastered the plan and the practical workings of engine boiler and condenser with their necessary connection and accessories he is initiated into the more abstruse considerations of heat streams and the heating motive power and cooling circuits At this point thermodynamics is taken up and the calculation of the properties of steam as recorded by the Callendar tables The second division of the work deals with the dynamics of the steam engine in which the reciprocating engine largely figures The third division treats of steam turbines The work includes the author's researches in the science of the locomotive and his theories are in some aspects original and suggestive The diagrams charts and tables form no small part of this large and thorough volume and they are so incorporated and explained as to be in the highest degree helpful to the student

DIRECTORY OF MERCHANTS AND MANUFACTURERS IN INDIA, 1915 Rajkot Kathiawar India Laxmichand Dossabhai & Bros 8vo, 500 pp Price, 3 rupees

Importers and exporters may find in this directory information of value It lists a wide range of occupations and manufacturers from accountants and architects to agricultural supplies household furniture clothing brassware, food products and perfumery It also gives banks and bankers, consular officers and governors staffs. It aims at presenting the most vital industrial information in a low priced and compact form

ESSAYS FOR COLLEGE ENGLISH Selected and Edited by James Cloyd Bowman A M Louis I Bredvold, A M L B Greenfield, Ph M, and Bruce Weirick, A M New York D C Heath & Co, 1915. 8vo, 447 pp

We are pleased to meet with so meritorious a collection of modern essays addressed to the freshman taking a technical course. Many of the essays deal with rural and agricultural conditions and problems, some are on science and scientists, one discusses education, another social psychology, yet another the conservation of natural resources. Most of them made their first appearance in standard publications, and among the authors are Woodrow

Wilson, Theodore Roosevelt and Paul Elmer Moore One or two older favorites are included An introduction treats of the analysis of the essay and puts the student in the way to determine the point that the author is endeavoring to make whether he really succeeds in making it, and if so whether he makes it in the most effective manner As an illustration the introduction presents a complete thought analysis of Matthew Arnold's "Literature and Science"

THE YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY New York The Marconi Publishing Corporation Over 800 pages profusely illustrated Price $1 net

The Year Book of Wireless Telegraphy and Telephony for 1915 appears to have been compiled along the same general lines as its predecessors of 1913 and 1914 perhaps the most valuable feature of the work being its international character Obviously the world wide travels of the radio operator have been constantly in the mind of the compiler for not only are the international radio laws and regulations covered at length but such information as the land stations throughout the world and monetary systems of the different nations their units of measure and other information of similar nature is presented in profusion The list of English terms encountered in wireless work together with their French Italian Spanish and German equivalents is also of great value as may be likewise claimed for the list of works published throughout the world on radio telegraphy which is perhaps the most complete of its kind

Even a most careful examination of the contents of this book fails to disclose the lack of any important information that might be of interest to radio operators and others engaged in the wireless field

SYMBIOGENESIS The Universal Law of Progressive Evolution By Hermann Reinheimer London Knapp Drewett and Sons Ltd 1915 8vo 125 pp

Those who have read Evolution by Co-operation by the same author will already be familiar with his general views In that work he endeavored to show that over and above Darwin's tenet of natural selection by competition stands the law of positive co-operation among organisms The present work is an amplification of this theory buttressed by quotations from Samuel Butler to Sir E Ray Lankester and illuminated by rays from all related fields of human knowledge In the so called love foods produced by sexual symbiosis in the plant we have so the author claims the lever which makes the whole world of animal life to move their elements react not only upon mechanical energies but also toward physiological and psychological elevation Nutrition and work, in their co-operative aspects are the two factors offered by the author as most truly illuminating the origin and transmutation of species and even more particularly of values Even though one may not wholly surrender to Mr Reinheimer's argument or accord to his theory that supreme importance with which he invests it there are in his volume so many important related facts and so much pause-compelling suggestion that his work must be reckoned with in any future study of Nature's methods in evolution

THE BOOK OF WIRELESS Being a Clear Description of Wireless Telegraph Sets and How to Make and Operate Them By A Frederick Collins New York D Appleton and Company 1915 8vo 222 pp illustrated Price $1 net

The boy who reads this manual will find descriptions of installations to suit all pocket books and all degrees of youthful intelligence and experience If his spending money is limited he will doubtless be most interested in the small outfit first given As his knowledge and his resources grow the long distance set will probably appeal strongly to him But in any case he will find all he wishes to know here set forth in simple words of explanation and instruction with all parts clearly illustrated and the cost of all materials plainly given When he has put up and used one of these sets for a time he will doubtless turn with interest to the final division of the work, which leads him through the processes of making induction coils and transformers There is also a chapter devoted to government regulations and examinations and a dictionary of the terms commonly in use among wireless operators

AEROPLANES AND DIRIGIBLES OF WAR By Frederick A Talbot Philadelphia J B Lippincott Company 1915 8vo 283 pp Illustrated $1 25 net

In some ways the aeroplane and the dirigible have proved disappointing when put to the test in war in other ways they have established themselves as a surprisingly efficient Fourth Arm and have modified tactics in a way entirely unforeseen Mr Talbot's popular survey of this subject includes Germany's rise to airship supremacy her aerial dreadnought fleet and its military value he describes the various aircraft of the fighting nations and follows their flights their accomplishments and their defeats methods of bomb-throwing are explained and many of the ruses used to mislead the airman are exposed The feasibility of mining the air against aircraft is discussed; the aerial torpedo, which the war

seems to have pushed into oblivion, is mentioned; and clear explanations are made of such comparatively little-known artifices as that of the ' smoke screen," used by the aeroplane much as a cuttlefish uses its inky fluid, to cloak its escape from danger The author has succeeded in placing vividly before his reader the part that the Fourth Arm is playing on the battlefields of Europe.

WHOSE SIN IS THE WORLD WAR? By Count Julius Andrássy Translated from the Hungarian by Ernest J Euphrat New York New Era Publishing House, 1915 8vo , 154 pp

Count Julius Andrássy the son of a minister of foreign affairs is himself a statesman and a close student of history and politics. His answer to the pertinent question of the title is, while of course open to some national prejudice at least dispassionately given, together with facts both for and against each nation involved Though his interpretation may at times be questioned, and some of his principles and deductions repudiated by broader view points yet his argument stands as a strong presentation of the Germanic cause, and is worthy of a careful reading It places at t e door of Russian aspiration the first responsibility for war it attacks while it to a certain extent excuses British policy and it condones Germany s action on the score that she had at stake interests vital enough to go to war about after adjustment in an amicable manner had become impossible.'

MECHANICAL DRAWING FOR COLLEGES AND UNIVERSITIES By James D Phillips, B S, and Herbert D Orth, B S New York Scott, Foresman and Company 1915. 8vo , 283 pp., illustrated Price, $1 75

Mechanical drawing is a primary step in almost all the constructive arts the study offers also an excellent training in observation and perception, thus combining commercial and educational value The course here offered is one of balanced appeal designed to develop the imagination and to perfect the coordination between hand and eye, while at the same time presenting the latest and best commercial drafting room practice No previous course of study is necessary to mastery of the lessons which stand complete in themselves, although they are to be followed by a text for high schools the two books constituting a complete course in mechanical drawing

NATURE NOTES FOR OCEAN VOYAGERS By Captain Alfred Carpenter, R N, D S O, and Captain D Wilson Barker, R N R Philadelphia J B Lippincott Co, 1915. 8vo , 181 pp 189 illustrations, including map of the world Price $1 75

These notes form an attractive volume for either easy chair or ocean voyagers They touch upon the many remarkable forms of animal life in the sea they picture plant life and sea weeds they deal interestingly with those things which have done so much to clothe the ocean in mysterious glamor—light and phosphorescence Reverting to the age of the early explorer they sketch for us the uncouth monsters with which his imagination peopled the waters Weather and waves are each given an adequate chapter, and the notes conclude with an account of old sea customs and chanteys.

HORSE TRUCK AND TRACTOR. The Coming of Cheaper Power for City and Farm By Herbert N Casson, Rollin W Hutchinson, Jr , and L. W Ellis Chicago F G Browne & Co, 1913 8vo , 200 pp , illustrated Price, $1

Edison once disposed of the horse in a single sentence, he said it was the poorest motor ever built. Mr Casson adds that it has an eating capacity of five acres per year a thermal efficiency of but two per cent, and an average working day of three and a half hours He tells us that our national bill for horse maintenance is $2 000 000 000 per year, equal to the total operating cost of all our railroad mileage' Mr Hutchinson follows with a series of incisive papers on motor transportation in its relation to scientific efficiency while Mr Ellis marshals some convincing arguments as to the value of the tractor on the farm Cost is consistently held in view as a subject of first importance and vital figures of equipment and upkeep are unsparingly presented The authors are authorities in their respective fields, and horse owners will find in their book an interesting and profitable study

DIE WELT DER VERNACHLÄSSIGTEN DIMENSIONEN Von Dr Wolfgang Ostwald, Privatdozent an der Universität Leipzig Dresden und Leipzig Theodor Steinkopff, 1915 8vo 219 pp , illustrated Price, M 5 75

"The World of Neglected Dimensions" is the first attempt ever made to present to the German reading public a broad and popular view of modern applied colloidal chemistry The growing importance of this branch of chemistry, with its close relationship to industry, deserves the careful attention of chemists and manufacturers. Two winters ago Dr Ostwald delivered, under the auspices of sixteen universities of the United States and Canada, a series of fifty six lectures; it is upon these that the present work is based. The chapter devoted to the technical and practical use of colloidal chemistry makes particularly timely and interesting reading.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions books etc This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet No attention will be paid to unsigned queries Full hints to correspondents are printed from time to time and will be mailed on request

(13005) I S Writes In the SCIENTIFIC AMERICAN for September 25 I notice the paragraph, Astronomy in the Public Libraries My library is one in which the school and public libraries are combined the town is very small and so far as I have observed no one is in the least interested in astronomy I should like very much to receive your suggestions on the most successful methods of getting them interested It does not seem advisable to put in many books until the interest is awakened and the demand for them comes Are there large pictures charts star maps or bulletins of any kind that could be used as posters to attract the eye? If you will suggest some things of this kind which can be obtained inexpensively I shall be glad to try them About the only material in the library on astronomy is Serviss Astronomy in a nutshell Evans Friendly stars and Mitton's Children's book of the stars besides the SCIENTIFIC AMERICAN I would like especially to arouse the school children so as to get them to watch for and use the star maps in the SCIENTIFIC AMERICAN A Your suggestions for interesting your people in astronomy are very good We agree with you that pictures should be hung on the walls to excite curiosity A large picture of the moon at first quarter and another at the full would be striking This with a picture of Saturn would perhaps be enough to begin with A good plain Atlas of the Heavens such as Burritt's with the constellation figures shown would be desirable on the tables You would better ask the aid of the University of Minnesota at Minneapolis and of Carleton College, at Northfield Minnesota These colleges can give you much assistance in getting pictures and books The University is a state institution and will be much interested to assist you

(13006) I H asks There has been considerable argument over a certain question which I refer to you for settlement Is it any easier to walk toward the rear than toward the *front* of a rapidly moving train? Consider the speed as constant Please state the principles on which your answer is based A A person in a closed car in which the air is moving with the car can walk backward and forward with equal ease so far as we can see There is no question about it excepting as to the inertia of the person as he goes with the car And he still moves forward with the car as he walks backward in it So that his inertia of forward motion is not changed He is simply trying to move upon a moving car and still go along with it This he ought to do with no greater difficulty than upon a car at rest

(13007) A asks 1 What is magnesium and how is it prepared for a flash light? 2 Can anything else be used in place of magnesium which is cheaper than magnesium? 3 Please give me a formula for such a flash powder 4 What is the relative lighting value of such a powder? 5 How does an aluminum flash compare with a magnesium flash? 6 Is there anything cheaper which can be mixed with it to make a stronger flash? I do not want chlorate of potash nor anything which would be explosive 7 Where can magnesium in the mineral form be procured? A 1 Magnesium is an element just as iron and copper are It exists abundantly in nature being the sixth in the order of abundance in the earth It constitutes approximately 2 68 per cent of the entire earth Among the minerals in which it is found are magnesite dolomite soapstone meerschaum and hornblende Its sulphate is found in many mineral springs as Epsom salts Formerly the metal was separated from its compounds by chemical processes, but it is prepared at present by the use of the electric current It is reduced to a powder by mechanical means grinding and rubbing and the finest particles are separated from the coarser by flotation in water or by an air current Its inflammability renders the use of air for this purpose rather dangerous 2 Aluminum powder can be used for a flash light either alone or mixed with magnesium It is cheaper than magnesium but not quite so actinic Aluminum is ordinarily completely burned when blown through a Bunsen flame. 3 A flash light mixture has been made containing magnesium 3 parts aluminum, 2 parts, and chrome alum 10 parts This is said to burn with little smoke Powdered aluminum does not require magnesium to ignite it in a hot flame. 4 The actinic quality of the mixture given above would be slightly less than that of magnesium used alone. 5 We have stated under (3) that the actinic quality of an aluminum flash is less than that of magnesium. 6. We do not know any chemical to mix with aluminum other than magnesium for a flash light which would make a non-explosive mixture and improve the

quality of the light. 7 The magnesium minerals can be procured in America from dealers in minerals.

(13998) D. B R. asks What Government stations send out time signals and at what wave length do they operate? A. At the present time the following stations are sending out time signals at the wave lengths indicated: Arlington, 2,500 meters, Key West, 1 000 meters, New Orleans, 1 000 meters North Head, 2 000 meters Eureka, 1,400 meters, San Diego, 2 000 meters; Mare Island, 4,500 meters.

(13999) G H E asks What apparatus is necessary to receive signals from the Arlington station? I am located 700 miles distant A The most suitable apparatus would consist of an inductive tuner an Audion detector, a pair of high grade telephone receivers, and two variable condensers—one for the primary circuit of the inductive tuner and the other for the secondary While a crystal detector could be employed it would not be sufficiently sensitive to insure the reception of the Arlington signals under adverse conditions.

(14000) C. J asks 1 Has the ocean ever actually been measured in depth? If you will please answer this question and tell me how it was done I shall be very thankful 2 There is one more very queer question Why did not the *equinox* of this fall come Sept. 23 as it should but instead it came Sept 27? I have sent this question to several of the Boston papers, but they can give no satisfactory reply A 1 The bottom of the ocean has been reached by sounding in every place where sounding has been attempted You will find full descriptions of the sounding apparatus and the depths reached in a very complete work called "The Depths of the Ocean," by Sir John Murray who was an authority upon this subject We can send you the book for $7 50 The sounding of the deep sea is done just as any sounding is done by sending a weight down, only in this work an iron weight and a steel wire are used and not a lead weight and a line. 2 The Autumnal Equinox this year was on September 23, at 10 hours 24 minutes in the evening by Eastern Standard Time The equinox cannot occur as late as September 27 in any year The interval is the same each year between two autumnal equinoxes but the day of its occurrence varies somewhat because of the allowances for leap year Our Calendar Years change their length by a day every fourth year and this causes a change in the dates of the equinoxes

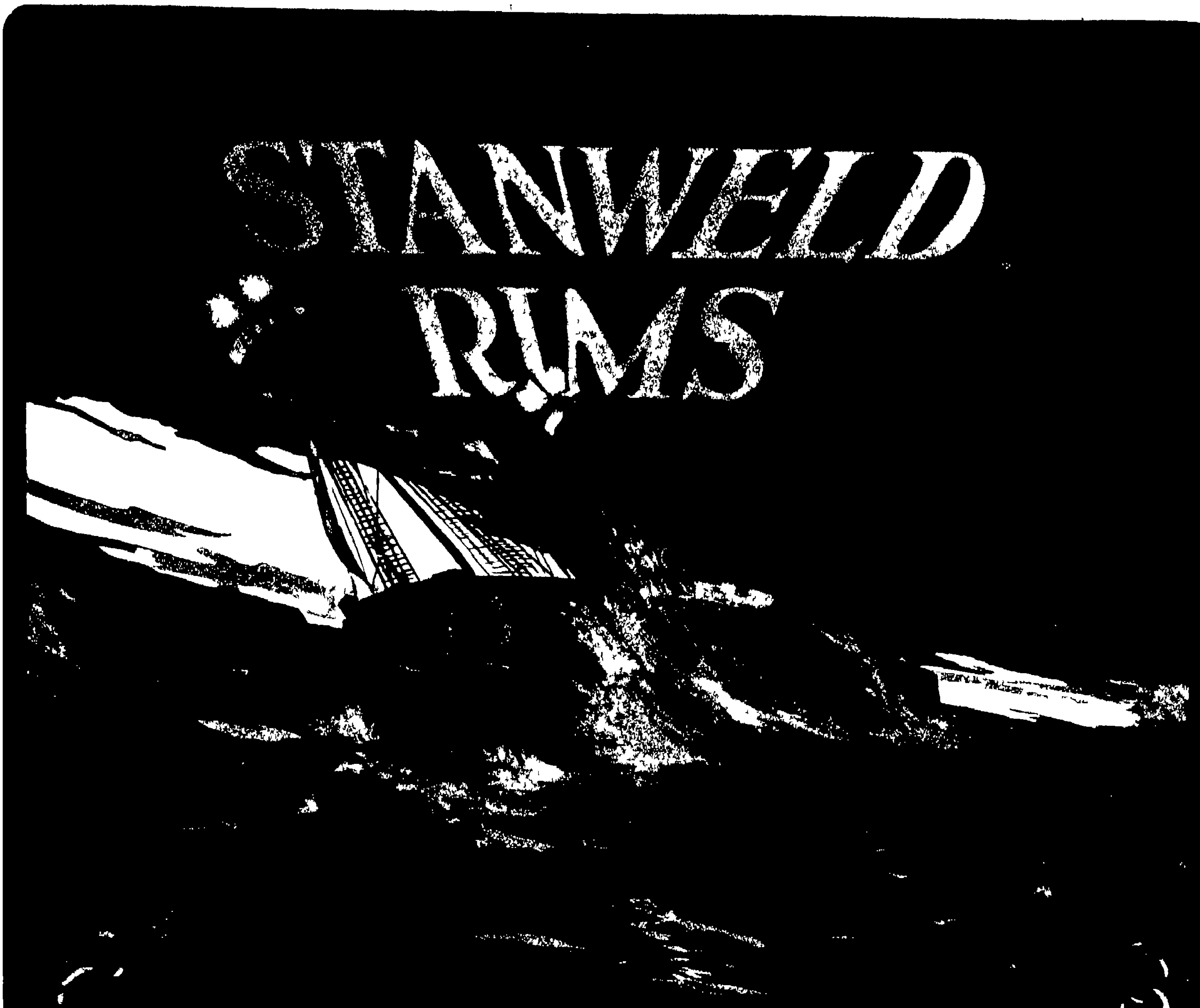
(14001) J L. P asks 1 Please give the derivation of the formulas $H = \frac{2\pi IT}{r}$ for magnetic coils, and $H = \frac{2I}{r_1}$ for a long straight conductor where I = current T = turns, r = radius of coil and r_1 = the distance in centimeters from a long straight conductor 2 What would be the cost per watt hour of electrical energy generated by a zinc-carbon sodium chloride battery? What is the voltage of such a cell? Is there any kind of battery which generates electrical energy cheaper than the zinc carbon sodium chloride battery? A 1 The derivation of the formulas which you give is quite too lengthy for Notes and Queries. It may be found in part in Stewart and Gee's Elementary Practical Physics, Vol 2, on Pages 214 to 229 or in Pender's American Handbook for Electrical Engineers in the Chapter of Electricity and Magnetism pages 383 to 411 A full demonstration is given in J J Thompson's and Maxwell's works All these freely employ the calculus, without which a full demonstration is not easily made 2 We can find no figures for the zinc carbon sodium chloride cell, nor have we seen or known of one for many years It may have been cheap but it could not keep a place for itself We have set one up and measured it for you It gave three amperes on short circuit and had less than half a volt The cell is very little cheaper than a LeClanche cell but electricity from it would be very expensive More than that the *current* dropped to half its value in the first minute through polarization, for which the cell makes no provision

(14002) G C F writes In your issue of August 7th in the Notes and Queries department, No 13067 W M asks if the sun ever sets on the United States or its possessions. Your answer is, in substance that from the most eastern point in Maine to the western extremity of the Philippine Islands is 176 degrees 35 minutes of longitude, or 3 degrees 25 minutes short of half way around the globe This, you state, represents 13 minutes 40 seconds in time, or allowing for refraction, there is actually 9 *minutes 8 seconds* when the sun is not shining anywhere on United States territory Have you not made a slight error? While the most eastern point of Maine is 66 degrees 45 minutes west longitude Porto Rico, according to the Encyclopedia Britannica, extends 1 degree 15 minutes farther east, or longitude 65 degrees 30 minutes. Taking these figures, the United States possessions extend through 177 degrees 50 minutes of longitude, or *only* 2 degrees 10 minutes short of half way around the earth. This represents, we believe, 8 minutes 4 seconds of time, or, allowing for refraction, an actual expiration of about 3½ minutes between the setting of the sun on the Philippines and its rising upon Porto Rico. If refraction can bend the sun's rays so that they come so very near shining on United States territory during the entire twenty-four hours of the day, it is, as you intimate, a poor calculator who cannot bend them the rest of the way. A. We have not received any other letter about the query whether the sun shone all the twenty-four hours upon the domain of the United States. We confess that we overlooked little Porto Rico, but she well deserves to be taken into the account. We will do so. According to the best figures we can find the eastern point of Porto Rico is in longitude 65 degrees 13 minutes 40 seconds west. The farthest point of the Philippines is according to the Encyclopedia Britannica in 116 degrees 40 minutes east. The latest edition of Bowditch's Navigator, issued by the U S. Hydrographic Office in 1914, gives the horizontal refraction as 36 minutes 29 4 seconds. Calculating the distance in degrees from these data, we find that the American domain extends over 178 degrees 6 minutes 20 seconds, while refraction extends the sunshine 1 degree 12 minutes 58.8 seconds. The sunrise band covers 179 degrees 19 minutes 18.8 seconds, leaving 40 minutes 41 2 seconds of the semi circumference, or in time 8 minutes 7 47 seconds from sunset on the western point of the Philippines to its rise on the eastern point of Porto Rico This is the best we can do for the United States.

(14003) J D Asks 1 If a train was running at a speed of sixty miles an hour and a man is sitting on the back end of this train with a gun that would shoot at the rate of sixty miles an hour and he shoots from the back end of this train in opposite direction what effect would this condition have on the bullet? 2 If the man with the gun was on the front end of this train and was to shoot back at a man on the back end of train and train to be going sixty miles per hour and the gun would shoot at the rate of sixty miles an hour what would be the result? A 1 In the case you propose the bullet after it left the gun would still move forwards with the speed of the train and backwards with the speed given it by the powder Since these two speeds are equal and opposite in direction the bullet would drop to the ground directly under the point where it left the gun 2 In this case the man at which the bullet was shot would be killed if the aim was good This may be made clear perhaps by asking if you could not throw a ball on a train to a man to the rear of the place where you were standing? Could you not toss a biscuit to a person in the next seat in a car either toward the front or rear? If you could toss a biscuit you could fire a bullet in either direction and with the usual result when a bullet is fired This matter seems very simple to us We do not know why it causes so much discussion

(14004) E R S Asks 1 Can you give me the different products of the Solvay process, and also their practical use and value? 2 If you place a given weight of water in a barrel or tank and add a given weight of live fish what would be the result in weight of the amount of water the fish would naturally displace? A. 1 The Solvay process is for the manufacture of sodium carbonate from sodium chloride The uses of sodium carbonate are many Its most familiar use is for washing It is the common washing soda It is also used in making glass, and soap, and in making other sodium compounds The value of glass and soap you doubtless know 2. If a live fish is put into a tank containing water, and the air bladder of the fish is not distended so that the fish sinks, the water displaced weighs less than the fish If the air bladder is distended to such an extent that the fish just remains under the water without rising or sinking, the fish displaces its weight of water If it floats with its back fin out of water it displaces its weight of water These three are the possible cases. It might also happen that the fish assisted itself to remain without sinking by the use of its balancing fins. It then displaces less than its weight of water

(14005) J H W asks 1—Is it a fact that ivory possesses a greater degree of elasticity than rubber? 2—Does a golf ball flatten out to the extent of 25% of its diameter upon being struck for a drive with a wooden club? I realize that in the latter question the extent to which the golf ball would give would be somewhat dependent upon the make of the ball and the force of the blow In answering the question please consider it as relating to an ordinary golf ball when struck for a drive of say 200 yards under average *conditions.* A 1—Elasticity is the property of the recovery of size or shape after distortion All bodies are more or less elastic. Probably no solid is perfectly elastic, so that it comes immediately back to its original size and shape Ivory will doubtless recover quicker than india rubber The limit of elasticity is the amount which a body can be distorted and still recover Rubber has a greater limit than ivory. When a body takes a different size or shape after distortion it is said to have a set. Rubber usually does not recover wholly after any considerable stretching or pressure. Rubber also loses its elasticity completely after some time Ivory retains its elasticity indefinitely. In this latter sense ivory is more perfectly elastic than rubber. Each is valuable in its place, and neither can take the place of the other Billiard balls cannot be made of rubber, nor can elastics be made of ivory. 2—We have no figures for the flattening of a golf ball when struck, but we hardly think it is as much as 25%. We should think it would crack before it yielded so much. Make an estimate of the force of the blow in pounds and place a ball under the weight equal to that number of pounds. You can then see how much the ball is flattened by the weight.



Signals *of* Safety

IT SHOULD be assuring to know that the rims on your car are made by an organization which has been called upon to make test-material for the most severe service known—the anchoring of Government Lightships—and that Stanweld Rims are made by the same men and methods

Rims are made by the electric welding process The strength of the rim and the safety of the car-owner depend upon the manufacturer's knowledge of that process

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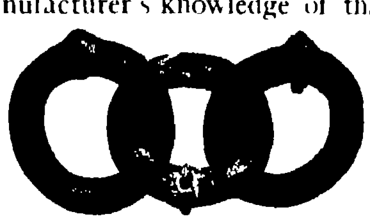
The satisfaction obtained from your purchase will be greatly enhanced if you are sure of the quality of material of which the article is made Make sure, therefore, that your car is equipped with Stanweld Rims



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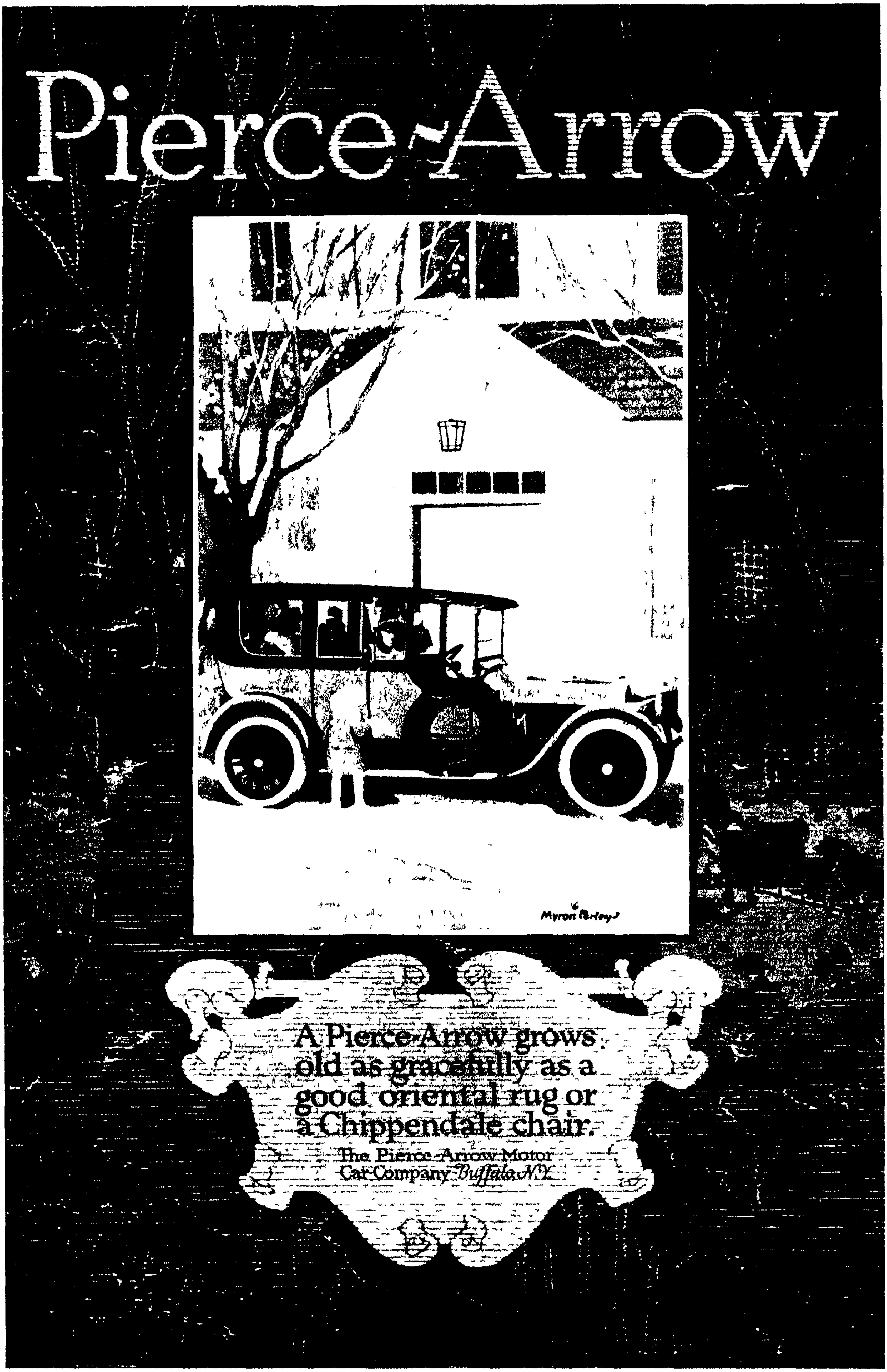
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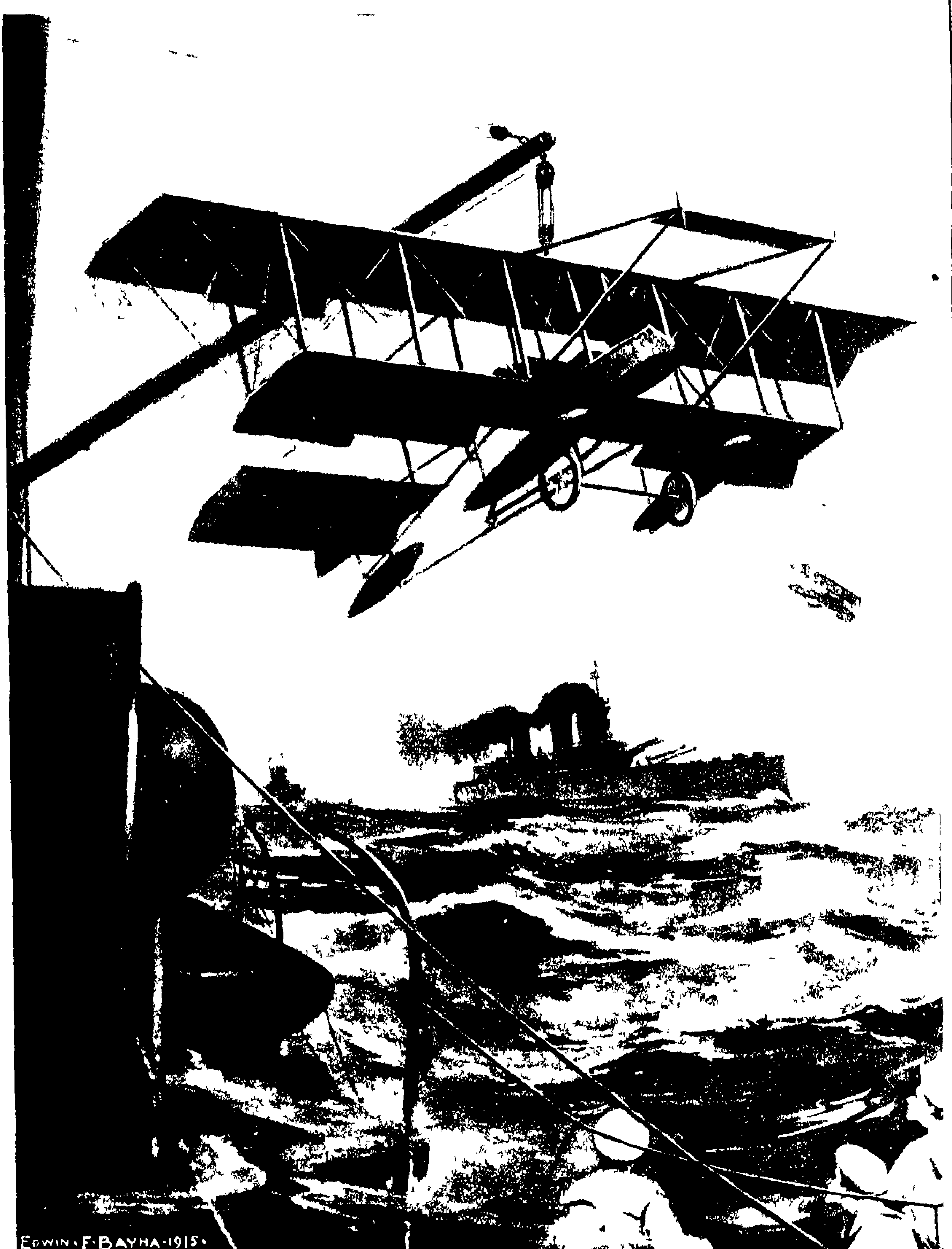

"THE EYES OF THE FLEET"—LAUNCHING A SEAPLANE

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The object of this journal is to record accurately and lucidly the latest scientific mechanical and industrial news of the day As a weekly journal it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns especially when such articles are accompanied by photographs

Industrial Preparedness for Peace

THE wealth of the United States in natural resources has not by any means proved to be an unmixed blessing in its effect upon the industrial and commercial situation Like every other pioneer people in a land of great fruitfulness we have gathered that fruit which was the richest the most plentiful and afforded the easiest plucking Hence Nature's prodigality has begotten in us certain habits of extravagance and improvidence of which there are only too many and too eloquent evidences on every hand We have exhausted the virgin fertility of our soil without effort at recompense—we have cut down our forests without any attempt at replanting—we have dug out the richest of our minerals and for want of a little care and patience have allowed millions of wealth to run to waste in the tail heap—and in our methods of manufacturing we have thrown away waste material which the more patient and thrifty European manufacturer has fabricated into a useful product with profit to himself and useful conservation for the world at large Not only have we been content to send our natural products abroad there to be worked up into finished articles and as such to be brought back for sale in our markets but we have been content to let the double shipment be made in foreign bottoms with an annual loss to us in freights of over $300 000 000

It took the upheaval of the European war to reveal to us the extent of our neglect and the wide range of profitable industries which due to our neglect have become the monopoly of our foreign competitors To-day we are confronted with an opportunity to enlarge our industrial undertakings and render ourselves independent of foreign markets, the like of which may never again be presented in the history of the United States.

In the belief that if once the country awakes to the facts it will make haste to seize the golden opportunity the SCIENTIFIC AMERICAN has decided to open an Industrial Department in which the conditions in the various industries affected will be clearly laid down and a plan of campaign outlined by which the country may take the fullest advantage of the opportunities developed by the present war This Department will be edited by a well known expert in the science of industrial efficiency who is now engaged and has been for some time past in making a close study of the industrial conditions and the opportunities which present themselves as the result of the present upheaval of trade conditions

We wish to make it clear that this Department will not deal merely with the question of scientific management and that the articles will not be merely a theoretical or academic study of the various problems On the contrary it will be our aim to treat the whole subject in a thoroughly practical manner and present a series of facts and figures and their lessons which can be put to immediate practical use in the development of existing industries and in the foundation and development of new industries for the products of which we have been dependent hitherto upon foreign countries

There is a great demand for cold facts and clear thinking on this subject of industrial efficiency and industrial preparedness for after-the-war conditions. In proof of this it is enough to remind our readers that a recent Congress was guilty of the amazing stupidity of passing a bill prohibiting the practice of scientific management and efficiency engineering in Government manufacturing plants This piece of abysmal legislative folly had its roots in the lobbying of the labor unions, which emboldened as they might well be, by their amazing success are now introducing a bill to prohibit the use by the Government of materials manufactured in plants which employ efficiency methods.

No small part of the space given up to our new Industrial Department must be devoted to ferreting out and exposing any future attempts to throttle American industries by iniquitous legislation of this character

The Navy We Need

THEORETICALLY the United States, being the richest country in the world, should have the strongest navy in the world—practically the United States should have a navy a little stronger than that of the nation whose policies are most likely to render that nation an enemy The strongest navy is possessed by Great Britain, but her language her laws her code of private public and international morality and above all her great international policies, are so similar to those of the United States that it is quite unnecessary for this country to possess a navy equal to that of Great Britain On the other hand, Germany which possesses the second strongest navy, believes that it has cause for a deep-seated grievance against the United States because this country has turned itself into an arsenal for the supply of ammunition to the foes of Germany moreover the United States believes that it has an even graver cause for grievance against Germany because she has deliberately murdered over one hundred United States citizens upon the high seas and by failing to disavow the act of her accredited executioner, gives to that deed the solemn sanction of the Imperial German Government.

It is for the above reasons that the SCIENTIFIC AMERICAN wishes to go on record once more as stating that although there is no practical reason why we should endeavor to make our navy equal in strength to that of Great Britain there is every practical reason why there is an immediate and most solemn obligation upon Congress at once to bend all the resources political financial and industrial of the nation to an urgent effort to bring our navy at the earliest possible moment up to that rightful position of second in strength which it held at the opening of the dreadnought era

If there is one great lesson more than another taught to us by the European war it is that we should avoid that pitfall of procrastination and futile effort which hitherto in all the operations of the war on land has caused the words Too late to be written upon the operations of the British armies Furthermore had it not been that the British navy long ago learned the great lesson of preparedness and lived up to it the war in Europe would have been over by to-day and the British Isles would have been overrun and held fast by the Prussian military machine

Last summer when the present Administration realised that it had made a grand political mistake in sealing the lips of its naval and military experts and preventing due naval and military preparation it called for a confidential report from the General Board of the Navy stating what kind of a navy this country should possess to render it absolutely secure The General Board knew perfectly well that the naval policy which Great Britain followed in protecting its own interests incidentally served to protect the interests of the United States It was well aware that the existence of the vast Dominion of Canada in the Western Hemisphere rendered the upholding of the Monroe Doctrine just as vital to the interests of the British Empire as it is to the interests of the United States. It was mindful of the fact that in 1903, when it drew up a programme of construction which would serve adequately to protect the interests of this country the navy by which it measured the strength of that programme was the German navy Last July when it made its report in response to the request of the Administration it was well aware that the conditions in 1915 were the same as they had been in 1903, and when it stated that the American Navy should be made equal to the most powerful maintained by any other nation in the world not later than 1925, it was giving an academic answer to an academic question, and nothing more. Theoretically it would be advisable to have a navy equal to that of Great Britain—practically the General Board of the Navy believes that we should employ the whole shipbuilding resources of the country in bringing up our navy as quickly as possible to that position of second in strength which it recommended in 1903, and which it believes would be sufficient to-day, as then, to preserve this country in absolute peace and security

Not only is it unnecessary, but it would be impossible to lay down any programme which would assure our overtaking the British Navy at any predicted date, and certainly not by the year 1925. To do this it would be necessary to know beforehand what will be the year-by year programme of construction of the British Navy, and, judging from the fact that since the war started she has added a dozen dreadnoughts, five new battle-cruisers and over seventy [illegible] destroyers to her fleet, it will be realised that if we started in a race to overtake her (something that we shall surely [illegible] do), she would [illegible] maintain her big [illegible].

But is it possible for us [illegible] to repair the shameful neglect of the past decade, in several [illegible] years of which we have authorised the construction of only a single battleship? The thing can be done only if this matter of naval construction be lifted out of the field of politics and considered and handled upon a high plane of disinterested regard for the safety and well being of the country. And in bringing this about, one of the most necessary steps is for the nation to put a stop to the suicidal policy of distrust and active animus against the shipbuilding interests, which has characterised the policy of the present Secretary of the Navy from the very day on which he took up the responsible duties of his office. It has been the constant aim of the Secretary to prejudice Congress and the country at large not only against the great shipbuilding firms of the country, but against all those firms which are engaged in manufacturing the material and supplies which are necessary for the shipbuilding and maintenance of the Navy The result of this policy has been that naval contracts are unpopular, and that there are some firms which definitely refuse to enter bids for naval work

Shortsighted indeed, has been the attitude of the Secretary of the Navy in this matter. If Mr Daniels had been possessed of that breadth of view and catholicity of spirit which are the essential qualifications of a competent Secretary he would have realised that it should be the aim of the Secretary to enlist the whole of the shipbuilding strength of this country in the work of naval construction Great Britain has done this so successfully that naval contracts are eagerly sought after by the big shipbuilding firms, which, assured of generous governmental support have not hesitated to erect building ways and extend their manufacturing facilities in order to take care of profitable government contracts, which they knew would come in due course.

It would be good business policy to replace the present unsatisfactory method of competitive bidding by a policy under which the shipbuilders would be paid for the cost of construction plus an agreed-upon percentage of profit Under this system the private yards would be perfectly willing to lay down new building ways and extend their shipbuilding facilities particularly if the present Congress should authorise a programme which would include all those battleships and other types of vessels which Congress has cut out of the General Board programmes during the past ten years.

To show what could be done, the SCIENTIFIC AMERICAN recently made an investigation, with the assistance of one of the leading officers of our Navy and found that with the enlargement of existing building ways and by the construction of additional ways, both at the governmental and private yards, it would be possible to take care of the nine dreadnoughts which are at present under construction or authorized and, by January 1st, 1917, to have twelve additional dreadnoughts under construction.

Official Endorsement and Patent Advertising

ONE of the first bills to be introduced into the Senate, when it convened last month, was a measure prohibiting the use of the name of any Member of either House of Congress, or of any officer of the Government by any person, firm, or corporation practicing before the Patent Office, for advertising purposes.

Those of the public who read this bill, no doubt, were surprised to learn that any such legislation is necessary Surely any Government official who realises the dignity of his position would not lend his name for advertising exploitation, but evidently there are many public servants who have not been restrained by such a sense of good taste We have before us the literature of patent attorneys filled with letters of endorsement from United States Senators and Congressmen, as well as minor Government officials, which not only commend the reliability of the attorneys in question, but also their competency and their efficiency. Are these officials ready to endorse every practice of the attorneys they commend? Have they investigated them thoroughly? Do they realise the uses to which their letters are being put?

To the man who knows, such endorsements mean nothing; commendatory letters are very easily obtained. But the obscure inventor, who has been made timid by accounts of patent trickery, and knows not in whom he can place confidence, looks upon such a letter as an official endorsement by the Government of the United States. He feels that he can rely absolutely upon a man or firm so highly recommended. It may never occur to him that the attorney in question was not carefully investigated before the letter was written.

It is more than a matter of [illegible]

Astronomy

The Harvard Observatory in Jamaica.—Now that Mars is attracting the special attention of astronomers, interest attaches to the question of the climatic conditions most favorable for observing the elusive and much-debated markings on that planet. Prof W H Pickering, in his Twelfth Report on Mars, comments on the relative advantages of his own station, near Mandeville, Jamaica, Prof Lowell's observatory at Flagstaff, Ariz., where Pickering spent six months when the observatory was established, and the observatory at Arequipa, Peru, where he spent two years. He declares that there is no choice between the best seeing at Mandeville, Flagstaff and Arequipa; but that good seeing is considerably more common at the Jamaican station than at either of the others. Flagstaff has a long winter, when the seeing is inferior, and Arequipa a long cloudy season, which comes at the same time with our northern winter.

A Lost Star Recovered.—The SCIENTIFIC AMERICAN of September 25, page 267, recorded the unsuccessful attempts of M. Raymond, of Antibes, to find the companion of Alpha Cancri, and the fact that the invisibility of the star had been confirmed at the Observatory of Marseilles. A reassuring note on this subject has, however, been published by Prof. Eric Doolittle in *Popular Astronomy* In spite of unfavorable conditions Prof. Doolittle had no difficulty in seeing the companion on three nights in October, and he declares that he finds no change in its brightness. He thinks the trouble with the French observers is that they expected the star to be of about the 11th magnitude, as estimated by Dembowski and Otto Struve, whereas it is actually much fainter, viz., about 12.2. Prof. Barnard also writes that he observed the star October 6th, but he calls it of the 11th magnitude. There have been many reports of variable double stars, but none of them has thus far been confirmed.

The Nomenclature of Variable Stars was discussed at the last meeting of the American Astronomical Society, and a committee was appointed on this subject, with S. D Townley as chairman. Various methods of designating variable stars have been in use and there is still much confusion in the matter Mr Townley has thus defined the three fundamental requirements of a system suitable for universal adoption (1) It must be simple, (2) it must be capable of indefinite extension and (3) it must not depend upon any particular epoch of time The Argelander nomenclature does not fulfill the first two requirements and has, moreover never been made all inclusive, as it has not been applied to such variables as Algol, Mira, Polaris, etc Mr Townley recommends the adoption in place of the Argelander system, of the plan proposed by Chambers André and Nijland, according to which the variables of each constellation are numbered in order of discovery, each number being preceded by the letter *v*, and followed by the name of the constellation for example *v*21 Persei

A Meteor Star Atlas—Under this title the Dominion Observatory, at Ottawa, has just published a collection of twenty star maps, with introductory text, prepared by Dr Reynold K Young for use in observing meteors and plotting their paths The track of a meteor is nearly an arc of a great circle It is therefore conveniently plotted on a map where great circles are represented by straight lines, and accordingly the maps in Dr Young's atlas are constructed on the gnomonic or central projection, which gives this desired property The amount of error introduced by using maps on other projections depends upon several factors, such as the fraction of the sky covered by one chart, the distance of the meteor track from the radiant, and the particular projection used. In some cases the error may amount to more than five deg, *i. e*, a path correctly observed, if produced backward on a map with unsuitable projection, may not pass within five deg of the radiant. The Meteor Star Atlas shows all stars down to the fifth magnitude

The Variability of Betelgeuse.—Mr Frederick C. Leonard has recently published a series of naked-eye estimates of the brightness of Betelgeuse (Alpha Orionis) made between July, 1914, and April, 1915, in continuation of earlier series which he has published from time to time. These show a decline in brightness during the nine months of about 0.80 magnitude, and an appreciably lower average magnitude than in the previous two years. In discussing the past history of this star and especially Sir John Herschel's observations, Mr Leonard states that he has seen Betelgeuse several times when it was unequivocally equal in brightness to Capella, and therefore the fifth brightest stellar object in the entire heavens, and he has never seen it as faint as Aldebaran, while Herschel found it, at maximum, but slightly superior to Rigel, and at minimum inferior to Aldebaran. He, therefore, raises the question whether the star has actually increased in average brightness during the last three quarters of a century. Mr. Leonard finds the fluctuations in this star's brightness to be irregular and non-periodic.

Science

New Paper-making Materials.—The U S. Bureau of Plant Industry has published a bulletin describing what appears to be a valuable new source of paper, viz, sacaton (*Epicampes macroura* Benth), a grass growing wild in abundance in Mexico and Central America This is but one of several possible paper-making plants that the Bureau has under investigation Year by year the demand for materials other than wood and rags capable of yielding paper on a commercial scale becomes more urgent. Wood is now used in this country for pulp manufacture to the amount of about 4,500,000 cords a year, and the cost of pulp-wood is steadily rising

The Distance at Which Heavy Gun-firing Has Been Heard during the present war forms the subject of some investigations by Mr M Christy, preliminary results of which are reported in *Nature* Mr Christy's house is at Chignal St. James, near Chelmsford, Sussex about 125 miles from Ypres (taking the latter town, for convenience, as a known center of the region from which the sounds come) Mr Christy states that he has heard the firing quite unmistakably since the beginning of the war, often all day and for many days in succession. He has collected records of the firing being heard at places throughout the southeast of England, the maximum distance from Ypres at which it was unmistakably heard being 140 miles, though there is a doubtful record of 150 miles. Apparently the direction of the wind has less to do with the transmission of the sound than certain other atmospheric conditions

Parasites and Diseases Carried by Dogs—Dr M C Hall, of the U S Bureau of Animal Industry, has just published a bulletin on this subject, in which he points out that the domestic status of the dog has not yet been adapted to the hygienic requirements of modern life, and declares that the destruction of all superfluous dogs, including those that are ownerless or whose owners do not keep them at home and in a sanitary condition, would mean an annual saving of hundreds of human lives and an increase of millions of dollars in the wealth of the nation He points out especially the danger of letting dogs take too great liberties with human beings, as, for example, licking the baby's face or the children's candy Important diseases conveyed by dogs to man and the domestic animals include rabies, hydatid, gid, muscular cysticercosis, or so-called "measles," in sheep, tapeworm in man and especially in children, roundworm in man tongueworm in man and stock etc

Standard Instruments for Measuring Evaporation—The U S Weather Bureau has just published a pamphlet describing the standard equipment to be used at the evaporation stations it is about to establish in various parts of the country, a first step toward securing a large body of comparable data in regard to this elusive element of climate The apparatus will include a circular evaporation pan of galvanized iron 10 inches deep and 48 inches in diameter, barely raised above the ground on a wooden support In the pan stands a still well, which provides an unruffled water surface wherein hook gage readings can be made with accuracy The hook gage is provided with a micrometer screw head, and gives readings to thousandths of an inch Near the evaporation pan is a standard rain gage, the measurements of which must be used in conjunction with those of the evaporation apparatus in order to determine the actual amount of evaporation Maximum and minimum thermometers, in a screen, and an anemometer complete the equipment. Observations are to be made daily about 7 A M, local standard time

Fox Farming in the United States—Much has been written during the last three or four years regarding the remarkable development of fox farming in Canada, especially in Prince Edward Island, where this industry originated Less publicity has however, been given to the spread of the industry in the United States In a bulletin on "Silver Fox Farming," just issued by the U S Department of Agriculture, it is stated that fox ranches are now established in Maine New Hampshire Massachusetts New York, Pennsylvania, Ohio Wisconsin, Michigan, Minnesota, Missouri Oregon Washington and Alaska The natural habitat of the red, cross and silver foxes (color phases of the same species) includes the greater part of North America from central United States northward to and including the treeless tundras. The silver phase, the pelts of which are most valuable, is in general more common as one goes northward, but is very irregular in its distribution The bulletin above mentioned gives complete directions for raising these animals The great value of the silver fox has led to extraordinary precautions against their loss. "On the more pretentious ranches the animals are regularly examined by a doctor and guarded by watchmen, bulldogs and burglar alarms. Cats are kept to act as foster mothers to orphan cubs. Foxhounds are trained to overtake and hold without injury foxes that have escaped, and blood hounds are employed to track thieves."

Industrial Efficiency

Working Capacity of a Single Gallon of Gasoline.—According to the *Wall Street Journal*, a single gallon of gasoline will do wonders almost anywhere, but nowhere has it been applied to better purpose than on the farm It will milk 300 cows bale 4 tons of hay, mix 85 cubic yards of cement move a ton truck 14 miles plow three fifths of an acre of land or generate sufficient electricity to illuminate the farm house for 30 hours.

To Recover the Iron in Discarded Wooden Cars, an Eastern railroad burns them Before setting the cars on fire however they are carefully inspected and all sills and other wooden parts fit for further use are removed The value of what remains is said to be so little that it does not justify the expense of tearing it down and accordingly it is cheaper to burn the wood leaving the iron which is sold as scrap

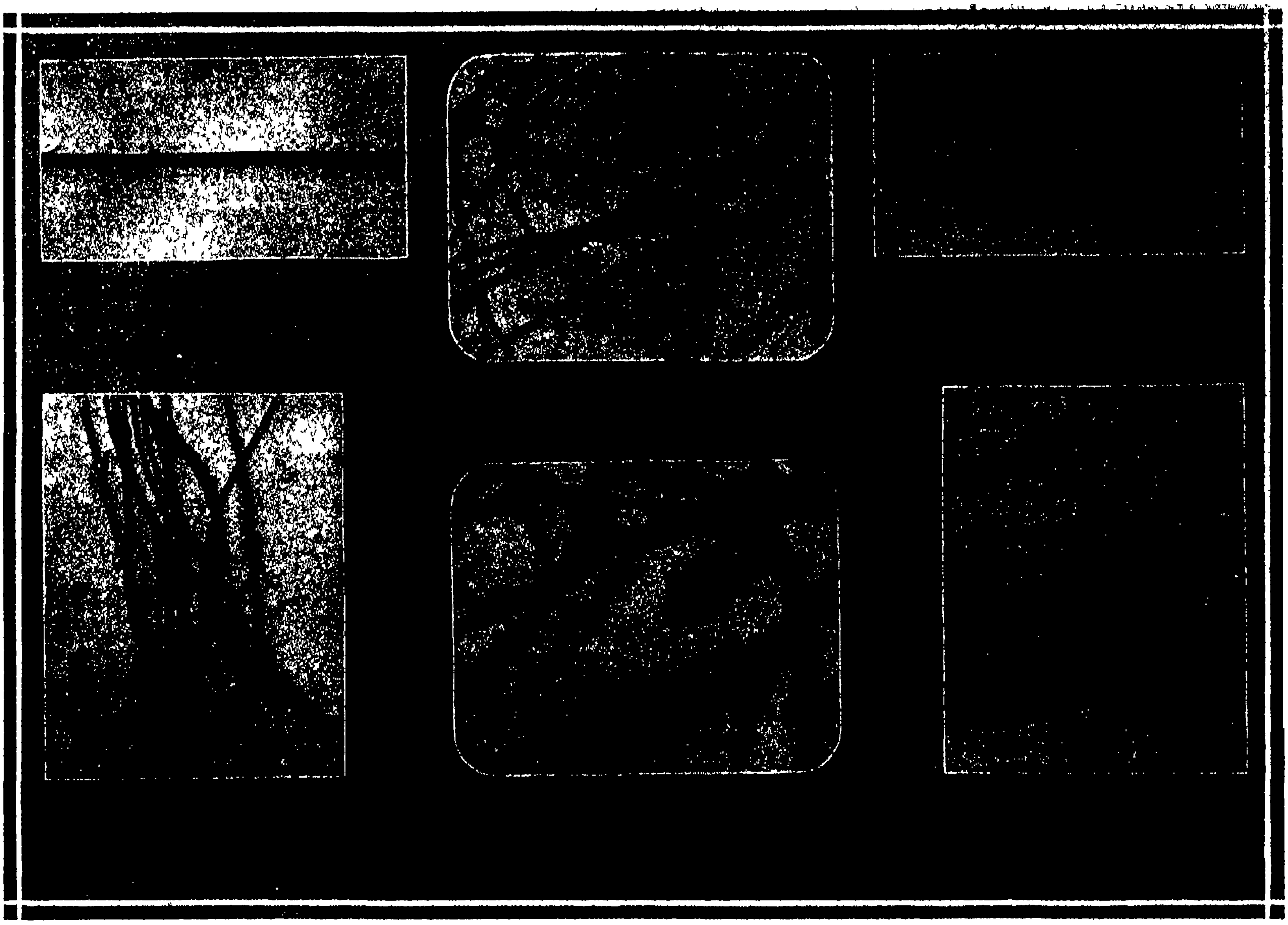
Panama Canal Slides and Transcontinental Transportation—The use to which the great waterway has already been put in transporting merchandise from coast to coast has been strikingly revealed by the closing of the canal due to the land slides As an example of the inconvenience caused, a large oil company of California has found it necessary to ship huge quantities of oil to the Atlantic coast via the transcontinental railways using trains of 25 tank cars carrying approximately 250 000 gallons, whereas in the recent past it has made all its shipments via the Panama Canal

Revenue from a Railroad Junk Heap—A leading Eastern railroad prides itself on the fact that it does not throw away a single article that has any value to man or beast. Everything that has been relegated to the scrap heap is afterwards sold if there is a market for it. In 1914 the scrap metal sold brought in to the company's treasury $2,157 241 24, which sum was $1,000,000 less than in 1913 Waste paper alone sold for $19,211 oil barrels for $22 430 and old rubber for $15,222. Locomotives and wooden passenger cars sold for $114 326 Old wheels, metals and wrought iron yielded more than $780 000 Other odds and ends brought in $121, 997

A Method of Preventing Oil Conflagrations has been tested out with no little success by a leading American oil producer Briefly, if an oil tank catches fire the heat immediately melts a fusible connection closing an electric circuit which in turn releases controlling valves of a tank containing a certain solution which then flows into lines running to the mixers installed in the tanks. Each mixer is fitted with fusible plug valves which melt out and the solution runs into the mixers, producing a foam that spreads over the surface of the burning oil and prevents access to air necessary to combustion In a recent test in Hawaii a fire was extinguished in 46 seconds after it had started 42 seconds having elapsed before the fuse plug melted

American Steel the Equal of the German Product—It is announced that American steel manufacturers have finally succeeded in producing a product that equals that of the famous Krupp works at Essen, Germany For years the Krupp works have been supreme in the manufacture of certain steels particularly the alloys used in the manufacture of crankshafts and other parts of gasoline motors where greatest strength coupled with the least weight is desired For the first year of the European war American motor builders were seriously handicapped by the German government's embargo on Krupp steel but in response to the urgent demand of the motor builders, the domestic steel mills set to work and at last have succeeded in equalling the German steels

Improvements in Sand-Blasting—A constant effort has been evinced on the part of foundrymen towards the improvement of sand blasting operations and the reduction of the dust hazard The earlier manual cleaning of castings with wire brushes has long since been supplanted by the tumbling mill which entirely eliminates manual labor although it has many disadvantages Fragile castings and those with delicate surfaces can not be treated in a tumbling mill and hence some other methods have been developed for such work Among them are sand blast machines equipped with revolving or reciprocating tables A most recent method of sand blasting and one which is applicable to the largest castings is that making use of a hose through which sand is driven by compressed air with great force The hose is provided with a nozzle so that the sand blast can be directed on the castings In order to prevent injury to workmen from not only the dust but the sharp particles of sand as well the work is usually done in a room especially intended for the purpose The room is usually equipped with a ventilating system, and the worker is provided with a substantial hood or helmet to protect his head and neck from the sharp sand that rebounds from the castings The workman must wear a respirator in which the sponge is constantly moistened, in order to breath the air without danger Only men in perfect physical condition should be selected for the work, since it is most trying on the lungs.



Highly magnified views of the fibres most common in the manufacturing of fabrics for wearing apparel

Textile Fibres and Their Characteristics

Microscopic Studies of Common Textile Fibres and What They Disclose

By Karl B Lamb, Ch E

FEW persons indeed know the actual appearance of the individual fibres from which a piece of cloth they may be examining is woven, or anything about the methods employed in preparing and using these fibres While experience has taught them to distinguish between wool, cotton and silk still these terms mean very little to them except as concerns the finished product.

How many realize that a single thread of No 6 sewing silk may contain as many as 1 000 cocoon threads side by side or that each silk cocoon contains from 2,400 feet to 1 mile of one continuous thread? It requires about 2,000 cocoons to provide one pound of silk therefore, there is represented in a pound of silk approximately 5 000 000 to 10 000 000 feet or in round numbers 900 to 1 800 miles of fibre Considering the higher figure this is enough to stretch nearly two thirds the distance across the United States!

Equally startling is the fact that each wool fibre as it comes from the back of the sheep is covered with tiny scales and that it is the interlocking of these scales which enables wool to be "felted" It is likewise interesting to learn that wool is reclaimed from old clothes and rags and rewoven into cloth, and that the reason why cotton can be spun into very fine, strong yarns is because the cotton fibres are of a very fine diameter and are flat, twisted ribbons in structure, which fact enables them to "kink" together and interlock.

The accompanying enlarged views of a few of the common textile fibres disclose certain characteristics of these fibres which are unknown to the naked eye The first illustration Fig 1, shows a single cocoon thread as it is spun by the silk worm, greatly magnified This raw silk is composed of about 80 per cent pure silk and 20 per cent silk gum The silk itself is formed by two glands in the body of the worm, and during the spinning of the cocoon it flows through two channels in the head of the worm into one exit tube The silk is, therefore, composed primarily of two single threads or filaments. At the same time as the silk filaments are being formed, the silk gum is being prepared by two other glands and flows out with the filaments, cementing them together This gum is of the consistency of fairly thin fluid when it emerges from the glands but it quickly coagulates upon coming in contact with the air In Fig 1 the twin structure of silk fibre can be readily seen

In Fig 2 appears a photomicrograph of a silk fibre, showing a defective spot where the gum has failed to hold the two silk filaments together, allowing them to split apart. This view, as well as that appearing in Fig 1 depicts the characteristic glasslike smoothness of the silk fibre, which property gives it the beautiful lustre that distinguishes silk fabrics.

The next photomicrograph, Fig 3, shows a mass of cotton fibres that, as can be seen, are in the nature of flat, twisted ribbons. This peculiar structure of the fibre is characteristic and is the cause of cotton's most important trait, namely, the facility with which it may be spun into very fine and strong yarns. As will be seen from the photomicrograph, it is evident that when the fibres are twisted together the kinks interlock, thus forming a strong compact thread.

"Mercerised" cotton is formed by treating ordinary cotton with caustic soda, causing the fibres to swell and to a greater or less extent lose their twisted structure. They become smoother and thus give a much higher lustre to the fabric made from them.

A mass of Merino wool fibres appears in Fig 4. Merino is the finest of the wools, and a close examination of the photomicrograph reveals the fact that the hairs are covered with tiny scales. When the wool fibres are worked and massed closely together, the scales open up and interlock with one another. This feature results in "felting," which enables wool to be used for felt hats and other purposes.

In Fig. 5 appears an excellent example of the appearance of shoddy under the microscope. New wool fibres in cloth have clearly cut ends the same as when they were cut from the back of the sheep. Shoddy, on the other hand, is obtained from old woolen cloth by a process of tearing, hackling and combing, which leaves the ends of the fibres macerated and torn, as shown.

Magnified a great number of times, there appears in Fig 6 a mass of linen fibres. These come from the inner bark of the flax plant and are long and of great strength Accordingly, the fibres are fairly smooth and as a result good linen possesses considerable lustre

Solidified Naphtha

THE hydro-carbon oils have been solidified in the laboratory many times by many experimenters, but, heretofore, the process has not been exploited commercially. Now, however, a New England chemist has succeeded in solidifying naphtha on a commercial scale, and is putting it on the market in compression top cans, as a household commodity. The naphtha, which is solidified by a process analogous to saponification, has much the same appearance as vaseline, and is of about the same consistency It is claimed that it has many virtues which are foreign to the liquid hydro-carbon, chief among them being its solubility in water, which, combined with the fact that it has all of the grease-removing qualities of liquid naphtha, renders it a highly efficacious article when used in the laundry Used undiluted, it is said to be ideal for taking spots out of clothes, cleaning and polishing furniture, automobile bodies, etc It burns readily, but, not being highly volatile, will not explode under ordinary conditions.

Potato Peeler

A NEW form of potato peeler, which appears very practical as well as simple, is the object of a French patent of recent date. It consists of a large frame of wood or metal about 8 inches square, this being filled up by a honeycomb make-up of steel blades. The whole has a somewhat concave shape, and the blades are placed in the frame so as to make up small cells of ½ to 1 inch square, by the use of sets of longitudinal and transverse blades suitably inserted. It is claimed that this affords a very rapid potato peeler by rubbing over the sharp edges, and above all it can be easily cleaned.

Loud-Speaking Telephones as an Aid to Window Demonstrators

THE handicaps under which window demonstrators have labored in the past are too well known to require an elaborate explanation of them. Suffice it to state, however, that heretofore window demonstrators have had to possess not a little ability in pantomime acting, and such points as could not be conveyed to the audience by visual means have had to use the crude vehicle of lettered cards, a means at once time-consuming and unconvincing.

In an endeavor to give window demonstrators a better opportunity of exercising their salesmanship, an electrical manufacturer has recently introduced a loud-speaking telephone equipment especially designed for this purpose. As will be noticed in the accompanying illustration, the loud-speaking telephones, fitted with amplifying horns, are fastened outside the store window, while the demonstrator within uses a conventional type of telephone transmitter into which he speaks. If he desires to have both hands free, he can wear a transmitter fitted with straps which hold it in position, similar to the equipment used by telephone operators. Thus can the demonstrator go about his work without a pause, speaking all the while to his interested audience standing outside.

Window demonstrator addressing his audience through the medium of a telephone transmitter and loud-speaking telephones

Parallel Packing of Nails by Electricity

WHEN next you go to the hardware store to buy some nails, you may notice a rather startling innovation which has been made in the packing and handling of nails in bulk. Heretofore they have been dropped loosely into a keg and the pieces locking and interlocking as they do from a mass which is almost impenetrable to the scoop generally provided in the hardware store for the purpose of removing them from the keg. The scoop is almost superfluous, for the clerk is invariably compelled to remove the nails by hand and place them in the scoop in which they are conveyed to the scales. But now things are different. You will find the nails nicely and accurately arranged in a box, parallel to each other, so that their removal by hand is a simple matter.

The greatest advantage of the new method, however, is that the nails systematically laid in a box will occupy a little more than half the space required when they are dropped in the keg. In one of the accompanying illustrations the boxes being filled by the machine have a capacity of fifty pounds each although no larger than a five-pound confectionery box.

The machine for packing nails in the manner described is of German origin and just being introduced into this country. Its operation is based upon the principle that linear iron articles when brought into a magnetic field will automatically take a position parallel to the lines of force. The machine consists essentially of the electric paralleling mechanism, a feeding trough and a shaking device. By means of the latter, the nails glide gradually into the paralleling mechanism and while still falling are drawn in the direction of the lines of force. The nails are passed into a tray fixed between the two magnetic poles and at intervals the tray is pressed downward and the contents emptied into boxes. With but little adjustment the machine may be made to handle any size of nail. The paralleling mechanism uses direct current at 110 or 220 volts pressure.

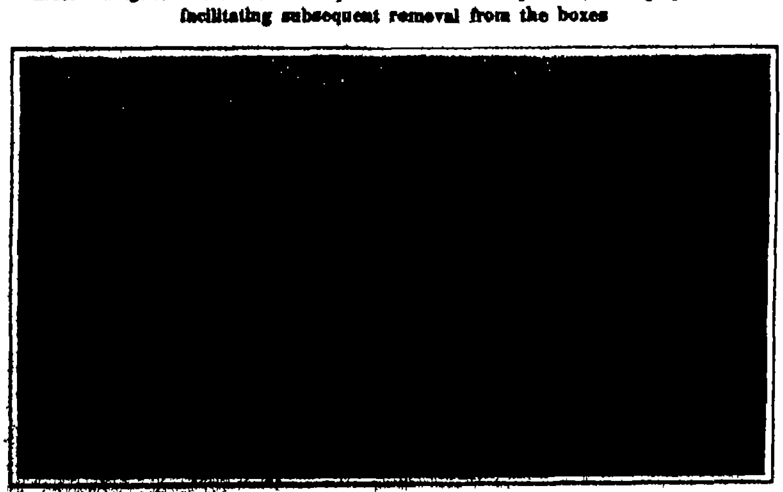
Old and new methods of packing nails

At the left 100 pounds of nails packed by electricity. In the center 100 pounds of nails packed by the old method, at the right, ten 10-pound cartons of nails packed by electricity

Electro-magnetic machine which packs wire nails in parallel, saving space and facilitating subsequent removal from the boxes

American All-Steel Battleplane with Turrets at Plane Tips

WHAT is claimed to be a noteworthy advance in heavier-than-air craft construction by the leading aeronautical experts of the United States was recently disclosed when an all-steel battleplane, designed by Grover C. Loening, received its initial tests. The new battleplane was flown at Readville, Mass., on December 12th, by Lt. Byron Q. Jones of the U. S. Army aviation corps, with eminent success.



Copyright International Film Service

Testing the engine of the new all-steel battleplane. The plane tip gun turrets are not as yet mounted in place

The new machine may be generally described as a biplane with a wing spread of 65 feet over all. Vanadium steel replaces the usual wooden framework, resulting in a flying machine of unusual strength. A most commendable feature is that all the parts have been standardized and stamped out by machinery, insuring perfect interchangeability and ready repairing. In fact, the construction follows the unit system throughout, the planes being made up in sections the number of which can be altered to meet the requirements of the service for which the machine is intended. Then again if a section of the planes has been damaged in use, it becomes a simple matter to remove the damaged portion and replace it with a new unit. Incidentally this form of construction is inexpensive.

Equipped with a 140 horse-power engine and a propeller mounted in front of the nacelle, the new battleplane is capable of a speed of 90 to 95 miles per hour. Its fuel tanks have a capacity sufficient for a flight of 800 miles.

Perhaps the most novel feature of this unique aeroplane are the two gun turrets mounted at the tips of the planes. These it is said, will be about 8 feet long by 2½ feet wide and will provide room for a rapid fire gun and gunner. The placing of the turrets at the plane tips permits of swinging the guns through a vertical arc of over 90 deg. and a horizontal arc of somewhat over 200 deg.

In times of peace the battleplane can be adapted to peaceful pursuits such as the carrying of mail and express packages by using the gun turrets as baggage compartments, in which instance it is said they can hold about 500 pounds with safety and without appreciably altering the speed of the craft.

Animated Drawings in the Moving Pictures

PATRONS of the moving picture shows find much amusement in the animated cartoons wherein the moving parts of the picture originate in series of drawings of which each successive picture shows the object in a slightly advanced position from that which it occupied in the last preceding picture, and these when rapidly projected on a screen cause the persons, animals or other objects to appear to move in the same manner as they do in the ordinary moving picture. Patents have been granted illustrating efforts to facilitate the production of these cartoons on a commercially practical scale. One of these patents was issued in the summer of 1914 to John Randolph Bray of New York City. Realizing the labor of reproducing by drawing the background in each picture, this inventor prints on a series of sheets of thin transparent paper the same background or grouping of stationary objects. The artist then draws on each printed sheet the objects which it is desired to represent as moving, such moving object being drawn on the succeeding sheets in slightly advanced positions. After the series of sheets or pictures are completed they are photographed in succession on a kinematographic film which may then be projected upon a screen in the usual manner.

Since the Bray patent a patent relating to the subject has been issued to Earl Hurd of Kansas City, Mo., in which a background containing the stationary parts of the scene is produced on a sheet and the movable objects are produced in successive positions or poses on separate sheets of transparent material and then photographed in succession on a kinematographic film, each picture of the series being formed by a separate sheet of the transparent material placed in front of the background sheet, the latter being visible through the transparent sheets on which the successive positions of the movable objects are produced.

Strategic Moves of the War, December 30th, 1915

By Our Military Expert

THE Turkish theater of war is now of particular interest, for the formation of a strong Teutonic army of invasion to be directed against Egypt and the Suez Canal is currently reported. Such invasion may be attempted coincident with the completion of the railway from Scutari to Medina running through Palestine, but the consensus of opinion of those who have studied the situation holds that tremendous difficulties must be overcome before any local measure of Teutonic success can be reaped, while preponderant numerical strength is essential for such a serious undertaking due to the great length of the line of communication and its vulnerability From Scutari to Maan, where the railway bends to the east near Akaba in Palestine, is twelve hundred miles, and the way is threatened in many places

That any such attempt will be made at present is scarcely credited unless, indeed, the invading force be composed almost exclusively of Turkish troops, numbers of which are engaged elsewhere It presupposes a change in the existing general situation If a movement in force is attempted, Saloniki may be abandoned by the Entente and the forces now held there be shunted, via the Mediterranean to the el Arish Akaba line, which guards the northern approach to the Gulf of Suez and the canal proper And whereas the Mediterranean will be available to the Entente for supply lines, the railway is apt to prove inadequate for Teutonia's similar needs.

The much mooted question as to whether the Central Empires are feeling the pinch of adversity through food shortage and the lack of materials for the manufacture of munitions and other necessities, may well draw attention to the very interesting map accompanying this article, upon which is indicated the location of natural resources of the territory within a radius of about 600 miles, surrounding the Black Sea

First and foremost, even beyond the necessity for war supplies, arises the food question. In no possible way can a war be more quickly concluded than by the cutting off of food supply to an opponent. In the Franco-German war Paris was only starved out after a desperate defense. The acquisition of Turkey as a Teutonic ally opened up the resources of that country as a food depot, rendering available to a certain extent, an amount of foodstuff over and above that required for home consumption. Along the line of the Bagdad Railway—the portion beyond the northern border of Mesopotamia being as yet unfinished—are to be found certain cereals and other foodstuffs which may be utilized for export into Teutonia But Turkey is neither a wheat nor yet a corn country—products much in demand at the present time

That portion of Bulgaria to the north and northeast of Philippopolis, which might almost be called an agricultural oasis of arable land in a desert of Balkan mountain, produces a considerable quantity of wheat which has become available through the alinement of Bulgaria with the Teutonic cause, other wheat lands are to be found in Roumania In the light of the latter's position of armed and wavering neutrality, how much of the produce expediency has permitted to flow out of the state living under the probability that within a short time it will be needed at home is problematical

Russia is in far better case The lands skirting the northern shores of the Black Sea constitute a wheat belt to a depth of three or four hundred miles, amply tapped by railways Figures are not available as to the extent to which the district has been drained of men for the forces in the field probably largely—yet, taking into consideration the lifelong habit of field labor to which the peasant women have been accustomed, it is reasonable to believe that a sufficient human force is available to insure a plentiful harvest

The beet sugar district of Russia lies close to a threatened locality for it is barely behind the Russian line where it fronts the Austrian north of Bessarabia Science having demonstrated the value of sugar as a food this cultivated resource is of some importance in the economic scheme.

The local and available minerals necessary to the manufacture of munitions are scattered. Iron deposits lie thickly in the Russian section north of Rostof, being surrounded by ample coal fields. The locale, controlled by four branches of a main railway line, provides far more raw material than the smelters of Russia can adequately handle under existing conditions. In the vicinity of Tiflis are other deposits of iron, for the transportation and utilization of which a railway runs from Tiflis to Poti, on the Black Sea Adjoining the petroleum fields to the westward of the Caucasus are other iron-ore sections, though transportation facilities are not as good here as in the aforementioned localities

Accruing to the advantage of Teutonia, iron is to be found in Turkey, just south of the Sea of Marmora. In addition, beginning about one hundred miles south by east of Smyrna, iron deposits range near the northeastern coast of the Mediterranean as far eastward as Alexandretta According to the latest available information, the Bagdad Railway is not connected as yet across the fifty mile gap extending from Adana toward Eregli, northeast of Alexandretta, until this discrepancy is remedied, the transportation of ore must be difficult, but in all probability the railway construction work is being pushed to the limits of endurance, not only for the sake of the minerals, but to establish direct railway connections with the Turkish interior and toward Egypt as speedily as possible

Copper, that most important element in the manufacture of certain war implements, is found in limited quantities in southern Bulgaria, while Turkish production of the metal is restricted to the vicinity of Tireboli almost at the southeastern bend of the Black Sea, and farther south along the Euphrates. But as there are no railway lines whatever in the section, benefit of the deposits cannot as yet be had by the Teutons except by laborious caravan convoy or on the Black Sea, subject to interruption by the Russian naval force

Russia possesses copper mines about a hundred miles south of Tiflis, and within comparatively easy reach of Julfa, just to the northward of the Persian border. The railway from Tiflis to Julfa opens this region for use, although its secure possession may be somewhat threatened by the proximity of Turkish forces which the balance of war may sway into active menace

Lead of principal use as a filler for the steel-jacketed bullets of modern warfare, is found in Turkey near Angora and southeast of Sokia, a railway terminus from Smyrna Zinc, manganese, iron and coal are also in the vicinity, which is very rich in minerals. Lead is also available near Eregli, on the Bagdad line.

Coal, that necessity for the generation of steam for locomotives and various factories, is rather abundant. The Entente is served by enormous coal deposits in the Black Sea section north of Rostof, and there are ample railway facilities to expedite its employment. Two hundred miles to the southeast, on the main line, are other coal deposits, nestling in the foothills of the Caucasus Mountains, while still others lie to the northward of the Tiflis Railway.

There are small coal deposits in Bulgaria. The south shore of the Black Sea offers a certain amount of the mineral to Turkey, while others lie north and south of Smyrna

The advent of the automobile as a principal means of field transportation, with the utilization of motor cars for countless purposes in warfare, has necessitated conservation of the natural resources from which gasoline is made. The Entente seems to have a little the better of the proposition, for in the map-section shown the Bagdad section appears to include the only petroleum fields at the service of Teutonia, and it is now threatened by the proximity of English forces in the vicinity of Bagdad. The Russian territory west of the Caucasus is rich in the product, transportation of which is easy by rail and water Other large reservoirs of petroleum are found near Vladikavkas, near the Caspian Sea.

The petroleum fields of Roumania are subject to the same question as affects the wheat of the section. In all probability much of this fluid finds its way into Teutonia through commercial transactions, for the supply is rather more extensive than would be needed for Roumania's possible future military operations.

In Turkey a certain amount of cotton is found available for Teutonic use. It is distributed as follows east of Smyrna, in the vicinity of Aleppo and on the Kurdistan Mesopotamia line, in the Mersina Eregli section, just north of the Island of Cyprus. All these sections are touched by railways, actual or under construction This cotton is used in the manufacture of explosives and for clothing.

Egypt, on the other hand, supplies for the Entente at least five times as much cotton as Turkey can offer to the Teutons, although there is at present some difficulty experienced in furnishing Russia a proportionate quota on account of the lack of ports of entry and the bulk of the commodity

Upon analysis, therefore, it is not believed that the food and mineral resources of Turkey and the vicinity afford any great material benefit to the Teutonic cause. The section has never been noted for its exportation of foodstuffs, and there is no reason to suppose that matters are greatly bettered under present conditions for, where transportation is concerned, all the eggs are in one basket—the Scutari Bagdad Medina railway

By Courtesy of Illustrated London News

What Turkey and Bulgaria have to offer their Teutonic allies

Death of William Howard Doane

HAVING attained his eighty-third year, Doctor William Howard Doane, noted as a hymn writer and composer of music, passed away on December 23rd at his home in South Orange, N. J.

It was through the invention of woodworking machinery that Dr. Doane, who was born near Norwich, Conn., became wealthy He was an ardent student of music and at one time toured the world making a study of the music of each nation and bringing back with him a rare collection of musical instruments, which he gave to the Cincinnati Art Museum. Dr. Doane wrote a number of church hymns, and it was due to him that Fanny Crosby reached her high position as a hymn writer In cognisance of his work the Denison University of Granville, Ohio, conferred the degree of Doctor of Music upon him. Dr. Doane at the time of his death was a member of several historical societies.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The National Guard

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue "Citizen" presumably from Texas takes exception to my article of October 23rd advocating strike duty be assigned to the regular Army only, thereby exempting the National Guard from such service. My only answer to this citizen is that, if Uncle Sam finds the regular Army the best policeman he has, it would be foolish to put any one else on the job.

That is not the only reason why the Guard should not have to do police duty. It is composed at present of a few business men and their clerks. I do not think it will be disputed when I say there is practically no brawn in the National Guard, and the strike duty requirement is the cause for the laboring man not being enrolled. My idea is to improve that which has merit as well as retain it. We need look no further than the National Guard for our citizen army. Membership in that body should be the natural vent for the patriotic feelings of every healthy man between the ages of 18 and 45. The Government pays all expenses, and enrollment does not mean that you will be taken from your labor, does not conflict with any religious principles. The only reasons there are not 10,000,000 men in training to defend their country instead of a little over one per cent of that number is, first, the false security from attack we have heretofore contented our selves with, and, second, the prejudice held by the great masses of the American nation, the working people, occasioned by the use of the Militia in labor troubles.

My high minded "Citizen" casts a slur on the National Guard patriots on general principles apparently. Let me tell you "citizen," as you call yourself, the National Guardsman is the only patriot, not a regular soldier or a sailor in the United States to-day, who is preparing himself to defend his country.

It is always well to acquaint oneself with the subject before venturing criticism. The governors of the states no longer have supreme command of the Militia. That office is now held by the President of the United States, and he can order them for service anywhere within the borders of the nation. The present Congress will no doubt make that anywhere under the Flag.

Likewise the statement is wrong that the last Congress made provision for enlistment in the regular Army for a term of eight months. I earnestly hope some such legislation will be enacted this term. Eight months' training will not make a soldier, but re-enlistments and a changed sentiment towards the profession of arms—which means the soldier—will do wonders for the Army. But do not for a moment think it is going to obviate the necessity for the National Guardsman. We need every man trained to take his place in the ranks, it is the only sure protection for a peace loving land.

If allowed to do so, the National Guard could furnish many times 100,000 men for an appreciable length of time each year, who would always be found with no doubt as to their standing in time of war.

PATRIOT

Colorado

Stability of Ships

To the Editor of the SCIENTIFIC AMERICAN:

With reference to the letters of Mr. C. D. Irwin regarding the "Statical Stability of Ships," permit me to say that it is by no means a simple matter, under varying conditions of load or trim and the effect of the human equation in arranging such elements, to assure perfect conditions of stable equilibrium in seagoing vessels.

When designing a "sister ship," if a little more cargo capacity is desired, or a slight increase of speed is demanded, the former can be easily attained by adding to the depth or length of the vessel, and the latter by adding to the boiler power, and by increasing the speed of revolutions. Should such desired increase be somewhat overdone, no harm will accrue. But, if greater statical stability is required, care must be exercised so that this element may not be overdone, as, short of being absolutely unstable, it is almost as objectionable to have too much stability of form, as too little. The great desiderata, since the proportionate dimensions of ships have been more scientifically defined, are that the masters and officers of vessels should possess at least a quasi-scientific knowledge of the principles governing the statical stability of floating bodies, and that all vessels should be supplied with curves of stability, or, at least, with metacentric diagrams. Vessels possessing absolute surface stability may readily be capsized by injudicious loading, just as the vessel having no stability of form may be rendered perfectly safe by judicious loading. No vessels ever capsized while possessed of a metacentric height. On the other hand, I have seen many large vessels which had no metacentric height, in the upright position, which were perfectly safe in any seaway, so long as the cargo or ballast was so secured that it could not shift. The "Austral," "Hammonia," and the "Canopus" were frequently afflicted with a minus metacentric *height*, and yet they rendered efficient sea service for twenty or thirty years. The most extreme case of disproportionate dimensions, however, I ever investigated during an experience of fifty years, was that of the "missing" steamer "City of Limerick," her extreme breadth was 34.4 feet and molded depth 31.9 feet which gave the extraordinary ratio of depth to breadth of 0.92 whereas this ratio should never largely exceed seven tenths, and in freight boats .6 should be the limit.

Regarding the deformity of the "Limerick" let me quote an extract from my paper read at the International Engineering Congress: "A few years since a deep and narrow steamer the 'City of Limerick' had been made still deeper by the addition of a third deck. The government authorities being advised by some of the best experts of the danger attendant on a sea voyage with that craft, she was stopped, after being fully laden, by my good friend Mr. Guiggin, the detaining officer.

It would seem that that gentleman, though an excellent shipbuilder, was ignorant regarding the cargo on board, or was unaware of the effect of the weights carried, and the distribution of same indeed so much so that all the powers of the Imperial government were insufficient to stop the departure of that vessel for as it happened at the time, she had stability due to weight, by virtue of some six hundred tons of railroad iron, stowed low down in the bottom. This lowered the center of gravity about two feet and secured a temporary metacentric height of nearly eight tenths of a foot. This, though small, gave the same result as would four feet added to the breadth.

With no iron in the bottom and the holds filled with homogeneous cargo, such as coal, there would have been *no metacentric height* the center of gravity being then fully three tenths of a foot above the metacenter. Indeed, the *height* of the *metacenter** was not more than three and one half feet. The 600 tons of iron stowed in the lowest position in that steamer was essential to obtain statical stability, but such a distribution of weight in a vessel having stability due to proportionate dimensions or form, would have caused excessive stiffness and rolling, because of the combination of low position of the center of gravity—due to weight, and the high position of the metacenter—due to the great breadth of the water plane. Let me predicate from this that the board of trade surveyors or inspectors of hulls, are not generally competent to rule on such points as these, especially as they have no rules to guide them."

JOSEPH R. OLDHAM

Red Fire

To the Editor of the SCIENTIFIC AMERICAN:

The best red fire, but not the cheapest is an old formula used by the Boston Comedy Company about 1860. It keeps well and with but little danger of spontaneous combustion. Sold then at $3 a pound. "Strontium nitrate powder four parts, potassium chlorate powder, two parts, gum shellac orange ground fine, one part. Mix well on paper." To be burned in a long narrow train.

GEO. H. HARTWELL.

Southbridge, Mass.

Light from Broken Crystals

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of November 20th there is an article on "Light from Broken Crystals."

In connection with this subject, I would add that the luminescence described is very nicely shown when breaking in a darkened room, the ordinary thin peppermint and wintergreen wafers, as purchased from any candy dealer.

CHAS. O. RHODES.

Groton, N. Y.

Opening for American Manufactures in India

To the Editor of the SCIENTIFIC AMERICAN:

One of the first results in India of the present war was the complete stoppage of all the supplies from Germany, Austria and Belgium of the hardware, glass and china wares, furniture, toys, chemicals, tissues, paper, drugs, tools, liquors and other goods that for many years have arrived from these countries. Much public interest is being shown in projects for the extension of local industries in order to render India self sufficing, but a reference to the current issue of the *Indian Textile Journal* will show how much preparatory work this country has still to accomplish in order to furnish her own requirements. Japan seems to be the only country that is trying to benefit by the present situation, but there seems to be a very good opening for many branches of American manufacture that at present are little known in our markets.

Our review of the industries of India is the result of nearly 30 years personal experience of the country and its people.

JOHN WALLACE, C. E.,
Editor *Indian Textile Journal*.

Bombay, India.

The Question of National Defence

To the Editor of the SCIENTIFIC AMERICAN:

In dealing with the question of national defence we should recognize that our position is peculiar to our selves. Unlike England loss of sea control does not mean certain national extinction although it does mean certain defeat. In order to insure victory we should have a navy, i. e. battle fleet, which would be second to none including England's at the point of contact. This does not mean a navy greater than England's but one second only in size. It should be large enough to make the dispatch of a battle fleet strong enough to cope with it dangerous to England's safety through attack by another power.

The only successful defence is attack. The present programme of the administration calls for 85 coast defence submarines as against 15 sea going, or fleet, submarines. For two reasons we may consider coast defence vessels as worthless.

First.—They cannot lie in line with the battle fleet in general engagement and that is what decides sea control.

Second.—They are worthless practically, for defence. If the enemy through the weakness of our battle fleet, secures control of the sea he will, as at the Dardanelles, take measures to neutralize them. Their cost put into the battle fleet would accomplish something towards securing sea control, which, after all is what a navy is for, not to maintain navy yards for the political influence of their workmen. We may safely say that the submarine bubble has burst. From such reports as are published, the only submarines accomplishing anything are of the sea going type. Therefore it seems the part of wisdom to construct such submarines as we build of this type.

Summing up the naval situation, we should develop and maintain a battle fleet able to meet and destroy the enemy on the sea. The money now wasted in the maintenance of unnecessary navy yards, for political reasons, keeping in repair ships worthless in a general engagement, for economical reasons and building small, cheap coast defence vessels, for sentimental reasons, put into the battle fleet would accomplish much.

For coast defence we should rely primarily upon *sea control*, secondarily on *coast defence fortifications* manned by a well trained personnel, with sufficient mobile forces to repel landing parties.

Our military development should follow the lines of attack. The Lord forbid that we should be compelled to wage war but if we must fight let us do the enemy all possible damage. It is better that his cities be laid waste than ours. The following suggestions are made to accomplish this end.

First.—"A citizenry trained and accustomed to bear arms." The Swiss military system would be ideal for this purpose.

Second.—A regular army of sufficient size to man the coast defences hold our colonial possessions and provide an expeditionary force sufficient to make and hold a landing on the enemy's territory until reinforcements arrive. For this purpose we should call for volunteers from those who had finished their first year's training in the national militia. Failing to secure enough men in any one year to fill the ranks conscription should be resorted to. These men to serve from three to five years with the colors and then go into the army reserve as distinguished from the militia reserve.

Third.—Abolish the state militia and have all military forces in the hands of the Federal Government.

Fourth.—The establishment of a council of national defence made up of the combined army and navy general staffs. This council to have entire charge of the making up and administration of the budget for national defence absolutely without regard to the political aspirations of budding congressmen.

Fifth.—The accumulation of sufficient stores and munitions to enable us to take and keep the offensive.

The Philippines should be held at all costs. From a sentimental viewpoint, that of passive resistance they are a source of weakness, but this viewpoint is unworthy of any consideration. From the point of view of strategy in over seas operations in the East they are a base of operations for attack.

I believe this development will actually defend us. The certain knowledge that we were prepared to carry the war immediately into the enemy's territory would act as a deterrent to the necessity of going to war.

"It is better to make the country an armed camp—if necessary—for our own soldiers than to have the enemy make it such for his."

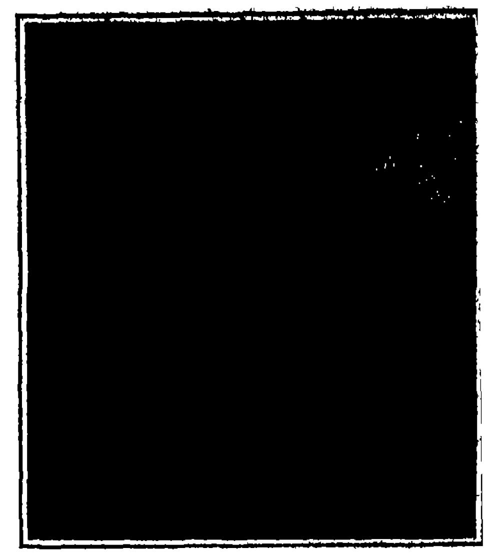
ROGER L. GORDON.

Somerville, Mass.

* This is not the metacentric *height*.

Electro-therapeutic device used in conjunction with hydriatric treatment

Weight-reducing machine making use of sinusoidal current



Device for stimulating the activity of the liver

Curing by Machinery

Growing Importance of Electrical and Mechanical Devices in Medical Practice

By Hinton Gilmore

MECHANICS has come to be the handmaid of medicine. The modern physician requires an elaborate equipment of machines in the practice of his profession. The physician of the old school got along very nicely with a thermometer and a saddle bag filled with a varied assortment of drugs. Even the more advanced physicians of 50 years ago contented themselves with very meagre equipment. It was not considered necessary for the ordinary practitioner to turn his office into a machine shop.

With the advance of both mechanics and medicine, however, it has been found that there are many devices which materially aid the progress of the patient towards recovery. It is estimated that where the old time physician could equip himself for his profession at a cost of $15 to $20, it now devolves upon the young physician to spend even as high as $1,000 for a very inauspicious opening of his practice.

The use of the X ray, both in diagnosis and for purposes of relief, involves extensive apparatus. The comparatively recent science of automatic exercise calls for more machines. The use of heat, called technically diathermy or thermotherapy, requires specially perfected devices. In fact, every phase of modern advance in medicine includes in its operation some machine which has been created to meet the emergency.

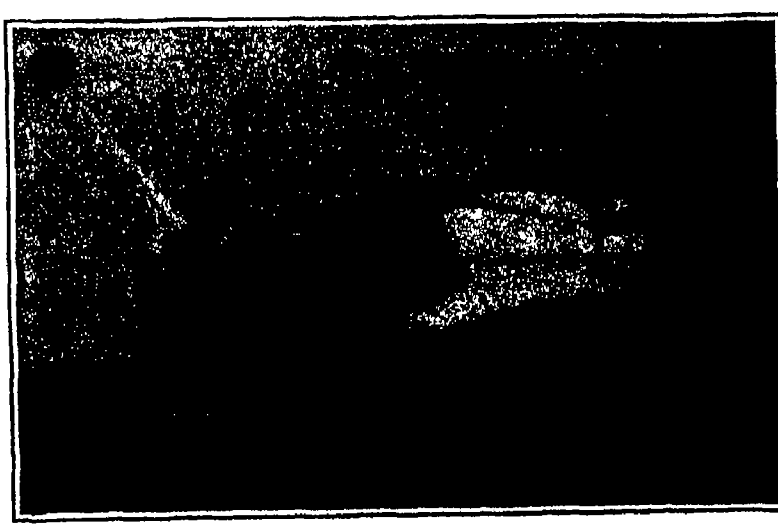
While the ordinary practitioner has found it necessary to stock his office with many mechanical devices, the greatest development in mechanical therapeutics has been reached in sanitariums. In these institutions, all properly approved curative measures are gathered under a single management and more attention is given to the use of machines than to the use of drugs. Whole departments are devoted to electrotherapy, diathermy, mechanical Swedish and other phases of mechanical therapeutics.

Electrotherapy involves the use of many special devices. The automatic exerciser in which the sinusoidal electric current is used is extremely beneficial in the treatment of rheumatism and similar disorders where there is a likelihood of muscular atrophy through enforced inactivity. The sinusoidal current while painless and shockless induces violent muscular contraction. By the means of electrodes it may be applied to the body in such a way as to exercise any set of muscles. The current is especially valuable in treating cases of obesity. Fat folks lose weight readily because of the violent exercise which it makes possible.

Electrical devices also assist materially in certain hydriatic or "water cure" treatments. Electrical baths are helpful in cases of rheumatism as well as in severe nervous disorders.

The electric light bath is a part of the equipment of practically every sanitarium. The simplicity and effectiveness of the electric light bath as compared with the turkish bath gives it a place, also in the mechanical equipment of the ordinary practitioner.

Mechanical methods are almost exclusively used in the administration of the curative system known as mechanical Swedish. Vibratory machines, percussion devices, tumbling sofas, "camels" and "horses" and other odd machines are found useful in the restoration of health. Vibrating chairs, operated by motors and so arranged as to set every muscle a-quiver have been found restful and wonderfully helpful in quieting angry nerves.



Exercising device that has proved wonderfully helpful for relieving the disorders incident to a sedentary life

Tilting sofa—device used in correcting prolapsed organs and in overcoming effects of sedentary existence

Abdominal kneading machines are also included nowadays in the equipment of sanitariums. The machines are readily beneficial in cases of intestinal sluggishness, prolapsed vital organs, inactive livers and other disorders often associated with sedentary existence. The mechanical "horse," a jog trotting machine that gives the rider all the benefits of an early morning gallop, is often used to set sluggish organs to doing their work more effectively.

Aside from the immediate curative advantages of many machines, mechanical pursuits of mild vigor are often valuable in restoring nervous patients to mental and physical stability. Wood carving, basketry, carpet weaving and clay modeling are some of the occupations most helpful in such cases. The secret of the work cure lies in the fact that a gentle occupation prevents the patient from brooding over his ill health. The introspective tendency is thus removed and the patient is then amenable to other therapeutic processes.

The value of mechanics in medicine has been amply demonstrated and the science of healing is coming to regard with increasing favor the aid offered by mechanical devices. The physician, in private practice, finds it incumbent to meet the advance made by institutions and the result is that the office of the modern physician is coming more and more to resemble a machine shop, just as the hospitals and sanitariums are being gradually converted into health factories.

The Current Supplement

AN important paper in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2088, January 15th, 1916, is on the *Physiological Importance of Phase Boundaries*, which is a consideration of the physical and chemical systems concerned in living cells. The explanation of the principles and operation of *Steam Turbines*, with a number of excellent illustrations, will be generally welcomed, as this class of prime movers has become so important for many purposes. *Nature Study in Agriculture* considers an important subject in its relation to educational motives and purposes. *The Nitrogen Problem in Arid Soils* discusses the causes and remedies for deficient crops. *Oil Films on Water and on Mercury* is a valuable study that throws light on the discontinuity of matter and the size of molecules. *Waste Pine Wood Utilization* gives an interesting review of the products that can be obtained from this material, and of the processes employed. *How Guncotton is Made* describes, with illustrations, the process for the manufacture of this high explosive. *The Electric Arc in Vapors and Gases at Reduced Pressures* discusses the possibilities of a lamp with unconsumed electrodes, and is accompanied by illustrations and diagrams. *Electric Activity in Ore Deposits* is concluded.

Exploring the Earth's Interior With Electric Waves

THE application of electric waves to the exploration of the earth's interior was first suggested by Truestedt, in 1902, and was subsequently and independently patented by Mueller. Recently the subject has been treated, both experimentally and theoretically, by Heinrich Loewy, who at first was interested in a purely scientific problem, the demonstration of the nucleus of liquid iron which Prof Wiechert conjectures to exist at a depth of more than 1,000 kilometers. Some preliminary experiments, however, showed that facts of great importance to miners can be learned from the application of electric waves to much smaller depths.

This possibility is a result of the varying physical character of the constituents of the earth's crust, in which insulators, which transmit electric waves, alternate with conductors, which impede their passage.

The experiments of Loewy and his collaborator Leimbach have led to the development of a number of methods of exploring the earth's interior The methods first employed are based on the reflection, refraction and interference of electric waves, and require both sending and receiving apparatus The presence and, in favorable conditions, the location of conductors (water or metallic ores) are deduced from variations in the strength of the received waves. The depth of the deposit is deduced from the inclinations of the sending and receiving wires for the maximum strength of the received waves. Newer and apparently more valuable methods are based on the variation in the emitted waves which is caused by the electric properties of the immediate environment.

In April, 1913, a company was formed in Goettingen for the development and exploitation of the various processes. The first practical work undertaken was the examination of a boring with regard to the danger of flooding. The boring was tubed and the tube, as it could not be removed, was necessarily employed as the conductor of the current producing the electric waves. The tube traversed a stratum of water, but the disturbing effect of this direct current was eliminated by a special electrical device, and the soil surrounding the tube was examined with complete success.

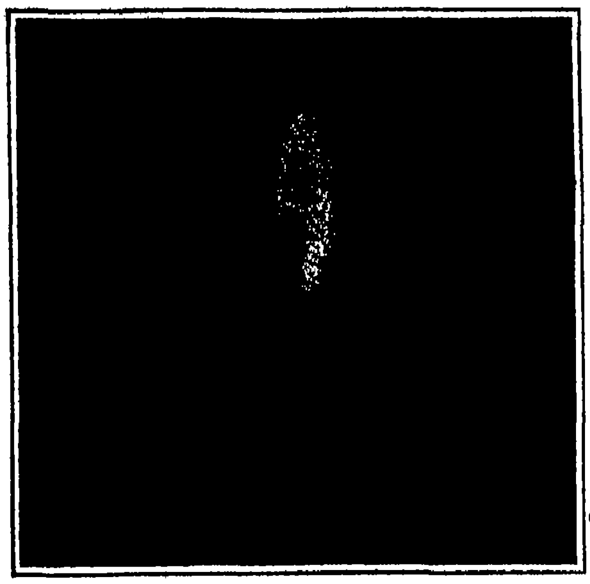
In another test the antenna was placed in a boring which was known to traverse a bed of clay, 20 feet thick, resting upon and overlaid by massive rock salt. The graphical records of the apparatus not only showed this source of disturbance in its known position, but also indicated the existence of a thinner stratum of clay lying below the known thick layer The boring crew testified that they had, in fact, encountered this second clay stratum.

From the position of the disturbance in the recorded curve the distance of the source of disturbance from the apparatus can be directly deduced For a time the principal field of application of the electrical methods was found in salt mines, in which, usually, the danger of flooding can be determined from a great distance

The success obtained in this field led to the employment of the electrical methods of exploration in tunnel building. Hitherto the flooding of tunnels in process of construction has been combatted by two principal methods. In one of these the mountain mass through which the tunnel was to be bored was frozen by means of pipes, often hundreds of yards long, filled with a freezing mixture, and the tunnel was then bored through the frozen mass. In the other method water-bearing crevices were filled with cement, an operation often requiring months of labor. Both processes are very expensive and neither is absolutely certain. In many cases the expense can be greatly reduced and the uncertainty eliminated by locating the danger ous spots by means of electric waves, thus insuring the application of the processes only where they are needed.

The electrical methods are especially valuable in cases in which they can be employed successfully to locate water and ore without boring. The dryness of the soil, the abundance of ores and the scarcity of water in German Southwest Africa induced the Goettingen company to send an exploring expedition to that colony in April, 1914. After three weeks of experiment the leader of the expedition reported the possibility of determining the presence, depth, and extent of deposits of ore and water, without boring, by means of easily portable electric apparatus.

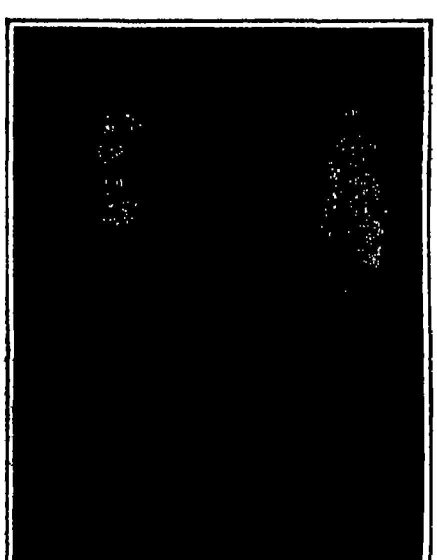
Meanwhile the company has found water and determined its depth, by the same method, in various places in Germany, and the indications thus found have been confirmed by boring.—*Umschau.*



Mechanical equipment for securing greater intestinal activity through a kneading process

Scene in a department of a sanitarium devoted to mechanical Swedish treatments

Mechanical "horse" which emulates the exercise derived from horseback riding



Percussion machine which is used in promoting organic activity

Prevention of Fog by a Blanket of Oil

THE use of oil as a preventive of fog holds forth much promise, although it would appear that its possibilities have not yet been fully determined in the absence of a series of exhaustive experiments. It is learned from the *Hydrographic Bulletin* that experiments to prevent the fogs in river valleys have been made in France with variable success, the best results being obtained by employing vegetable oils. The procedure is to cover the surface of the water with a thin film of oil which keeps the air from coming in contact with the warmer water, thus hindering the condensation of the water vapor It is believed to be possible for a ship which has to stop or anchor off a fog bound coast to create a clear zone around her by distributing storm oil for a time

Captain E K Roden, in charge of the nautical department of a well known correspondence school in writing on the subject of fog prevention by the use of oil cites two instances which are in no little degree convincing The first occurred when two demijohns of olive oil were broken and spilled on the deck of a steamer anchored off a small South American town, near the mouth of the River Parana At the time dense fog prevailed, but as the oil found its way to the water it was noted that the fog cleared over those portions of the surface covered with oil The second instance was observed on board a steamer at anchor outside of Magdalena, a resort southeast of Buenos Aires in the mouth of Rio de la Plata The fog was very dense and a boat was sent toward Magdalena with a dripping oil tank attached to its stern A clearing was noticed in the wake of the boat but a strong wind blowing the fog across the course of the boat soon made the clearing less distinct

According to Captain Roden in calm weather good vegetable oil can be used with advantage in clearing a pathway or zone through a fog bank provided the fog is caused by the evaporation of surface water With a strong wind the effect is lost, except possibly in the direction in which the wind is blowing The effect of wind, however may be overcome it seems by distributing oil over a considerable portion of the sea Inclosed waters, such as New York Bay might be cleared of fog by having several distributing stations for oil and taking advantage of tides in spreading the oil, thus minimizing the effect of wind

A Process of Cold Enameling

THERE are many small objects whose beauty is much enhanced by the application of a coat of enamel, but which are not capable of being fired A process of enameling these in the cold, so simple as to be quite practicable for amateurs, is described in *La Nature* as follows To a solution of sodium silicate, boiled in a closed vessel, there is added about five per cent of sulphate of lime This causes a precipitation to take place, the ulterior effect of which is to prevent efflorescences which would injure the looks of the enamel The solution after being once decanted assumes the consistency of a paste which is heated to about 75 deg Cent, to apply to the objects to be enameled. A second decantation takes place in the vitreous layer and this then takes on an unalterable translucence It may be tinted any desired shade either in the mass or superficially, the colors being fixed by tannates of gelatine and alum

Bureau of Standards Studies Specimens of Bronze

THE quality of metal castings is usually determined by measuring the properties of a test specimen cast from the same metal The United States Bureau of Standards has completed an investigation of the various foundry operations that influence the properties of the test specimen for one of the most generally used alloys, known as Government bronze having the composition 88 copper 10 tin, and 2 zinc The Bureau studied the effects of temperature on cast ings methods of gating casting molding kind of sand heat treatment and the effect of similar factors upon the resulting mechanical properties

A microscopic examination of the fractured test specimens showed that the most common source of weakness was the occurrence of oxides within the metal. Such oxides appear frequently as thin films throughout otherwise sound metal, producing a condition of brittleness and low ductility The results of such tests are of great importance to all users of alloys.

Morning and Evening Stars for 1916

By Frederic R. Honey, Trinity College

THE publication each year of the article Morning and Evening Stars affords the writer an opportunity to call attention to what may be called current events in the solar system. To this end tables are given which include the principal elements of the orbits of the planets, their conjunctions and oppositions, conjunctions of the planets, and their elongations, which give the dates when the planets positions on account of their greater distance from the sun are most favorable for observation. These positions may be verified by reference to the plots. The scale of the orbits of the major planets is very much reduced, which is apparent on comparing the orbit of Mars in the two plots.

The permanent members of the solar system include besides the periodic comets the asteroids many of whose orbits are very eccentric and are inclined at large angles to the ecliptic. But a description of these orbits which fill the gap between those of Mars and Jupiter would require separate treatment, and would exceed the limits of this article.

The Sun, the Earth, and the Moon

The sun and moon are apparently about the same size, i. e., they subtend nearly equal angles. This is proved at the time of a total or annular eclipse, the variations in their apparent diameter being due to the varying distance between the earth, the sun and the moon. Some idea of the great magnitude of the sun may be obtained by comparing the dimensions of these bodies. The earth's diameter is 3 $^{2}/_{3}$ times the moon's diameter, and it is therefore about 49 times its volume. The sun's diameter (= 864,392 miles) is a little over 109 times the earth's diameter, and over 1,300,000 times its volume. The diameter of the sun is 400 times that of the moon, and 64 000 000 times its volume. Hence it appears that at the date when the earth's distance from the sun is 400 times its distance from the moon, the sun and moon subtend equal angles, i. e., their apparent diameters are equal.

The sun's axis is directed to a point midway between Vega and Polaris, and its rotation in 25¼ days is in the same direction as the revolution of the planets—indicated by the arrows A. On account of the earth's movement in its orbit the sun's apparent rotation (the synodic period) is accomplished in 27¼ days.

The earth's equatorial diameter is 7,920.7 miles, and its polar diameter is very nearly 7,900 miles. Its axis is inclined at an angle of 66.55° to the ecliptic, and is directed to a point in the heavens about 1¼° from Polaris. The direction of the earth's rotation on its axis is indicated by the arrow shown at the date January 1st.

There will be a total eclipse of the sun February 3rd, an annular eclipse July 29th and a partial eclipse December 24th.

A partial eclipse of the moon will occur January 19th and July 14th.

The Terrestrial Planets

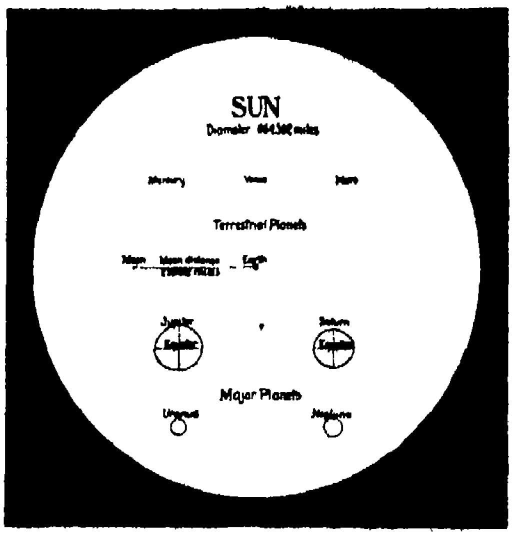
The mean distance between the sun and the earth is 92,897,416 miles and the linear eccentricity of the earth's orbit, or distance between its center C and the sun (= e) is $^{1}/_{60}$ of the mean distance. Moving with a velocity of 18½ miles per second, the earth completes its revolutions around the sun in 365¼ days, the average length of the year for four years including the present one (leap year) of 366 days. The earth's place in its orbit is shown for every fourth day. Intermediate positions and dates are easily interpolated. If the plot be placed so that the earth's position at any assigned date is between the reader and the sun the dates attached to the terrestrial planets will be read without turning the head.

Table 1 gives the diameter of each planet its mean distance from the sun in terms of the earth's mean distance, its velocity in miles per second; its period in years, and the eccentricity and inclination of its orbit.

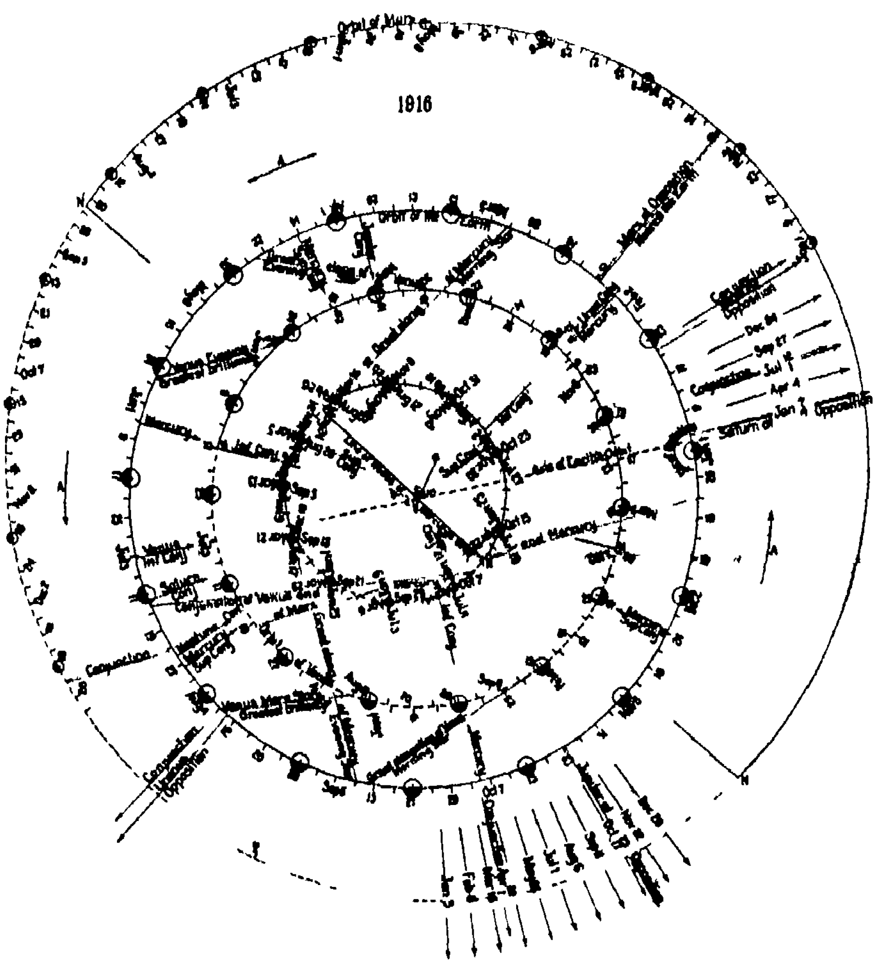
Since Mercury's velocity on account of the great eccentricity of the orbit, changes very rapidly between 35 miles per second at perihelion and 23 miles per second at aphelion the planet's position is shown at intervals of two days. The period is 88 days; and as Mercury makes over four revolutions during the year, four dates are attached to each position. The linear eccentricity is the distance between the sun and the center of the orbit.

TABLE I

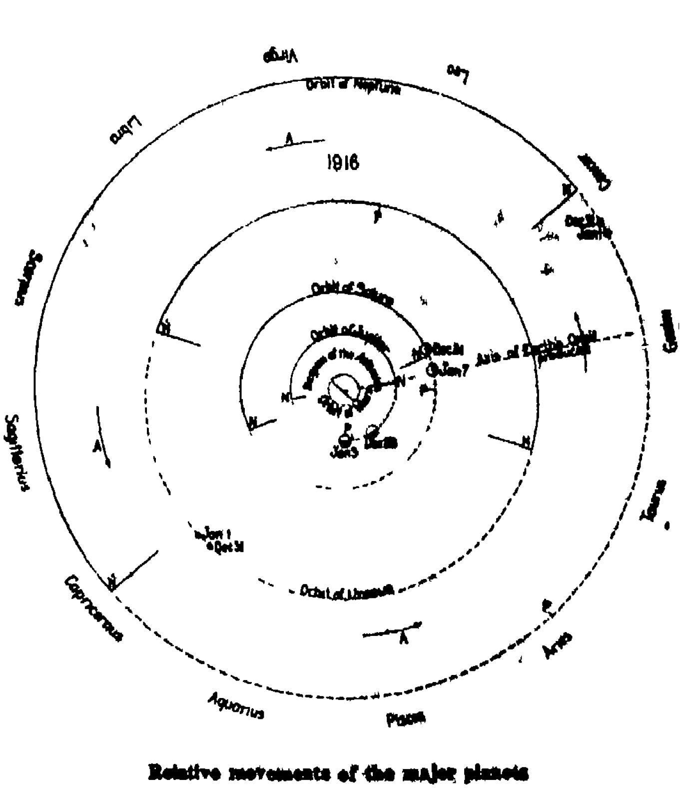
Planet.	Diameter Miles.	Mean Distance.	Period, Years.	Velocity, Miles per Sec.	Eccentricity of Orbit.	Inclination to Ecliptic.
Mercury	3008 54	0 387	0 241	23 to 35	0 206	7 00
Venus	7701 48	0 723	0 615	21 9	0.007	[illegible]
Mars.	4548 84	1 524	1 881	15 0	0 093	1 85
Jupiter Equatorial	90256 08	5 203	11 862	8 1	0 048	1 31
Polar	84770 42					
Saturn. Equatorial	75456 40	9 539	29 458	6 0	0 056	2 49
Polar	69781 78					
Uranus	30193 44	19 191	84 015	4 2	0 047	0 77
Neptune.	34823 34	30 071	164 788	3 4	0 008	1 78



Size of the sun compared with those of the planets



Relative movements of the terrestrial planets



Relative movements of the major planets

The eccentricity of the orbit of Venus is so small that it is indistinguishable in the plot. As a consequence the planet moves with a nearly uniform velocity. It completes its revolution in 224.7 days. The dates for the first revolution are attached without the orbit, and those of the second revolution within the orbit.

The linear eccentricity, or actual distance from a the center of the orbit of Mars to the sun is greater than the corresponding element in the orbit of any of the terrestrial planets.

The position of perihelion or point of each planet's nearest approach to the sun is marked *P*, *N* is the ascending node where the planet passes from the space below the ecliptic to that above, and *N'* is the descending node.

The Major Planets

The directions of the planets Jupiter and Saturn as seen from the sun are shown by arrows at intervals of 36 and 88 days respectively, and those of Uranus and Neptune at the dates of opposition and conjunction. A separate plot of the orbits of these planets gives their positions at the beginning and the end of the year. These positions should be compared with those indicated in the plot of the terrestrial planets.

The earth will be at perihelion January 2nd and aphelion July 2nd. Mars will be nearest the earth February 9th, at aphelion March 18th, and at the descending node August 22nd. Jupiter will make the perihelion passage April 17th; and Saturn will reach the ascending node September 27th.

Conjunctions and Oppositions

Oppositions and conjunctions with the sun are fully illustrated in the plot of the orbit of the terrestrial planets. In order to avoid confusion only two conjunctions of the planets are illustrated, viz., those of Mercury and Venus, July 18th, and of Mercury and Mars, December 21st. The other conjunctions may be easily verified by the application of a straightedge which will pass through the earth and the planets at the dates given in the table. The dates of great elongations of Mercury and Venus, and those of Venus' greatest brilliancy may also be verified.

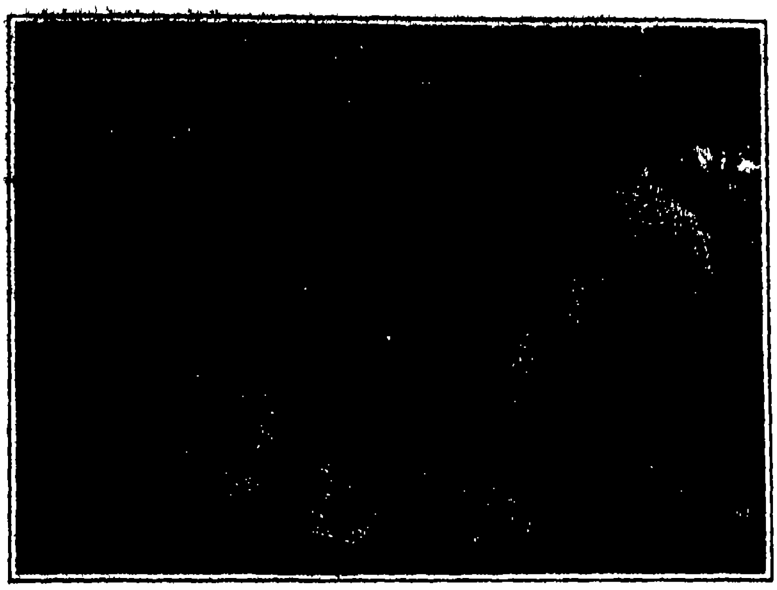
TABLE 2. GREENWICH TIME

Planet.	*Conjunction.*	*Opposition.*
Saturn		Jan. 4
Neptune		" 23
Mercury (Inf.)	Feb. 4	
Uranus	" 3	
Mars		Feb. 9
Jupiter	April 1	
Mercury (Sup.)	" 14	
Mercury (Inf.)	June 2	
Venus (Inf.)	July 3	
Saturn	" 13	
Neptune	" 23	
Mercury (Sup.)	" 27	
Uranus		Aug. 16
Mercury (Inf.)	Oct. 4	
Jupiter		Oct. 22
Mercury (Sup.)	Nov. 28	

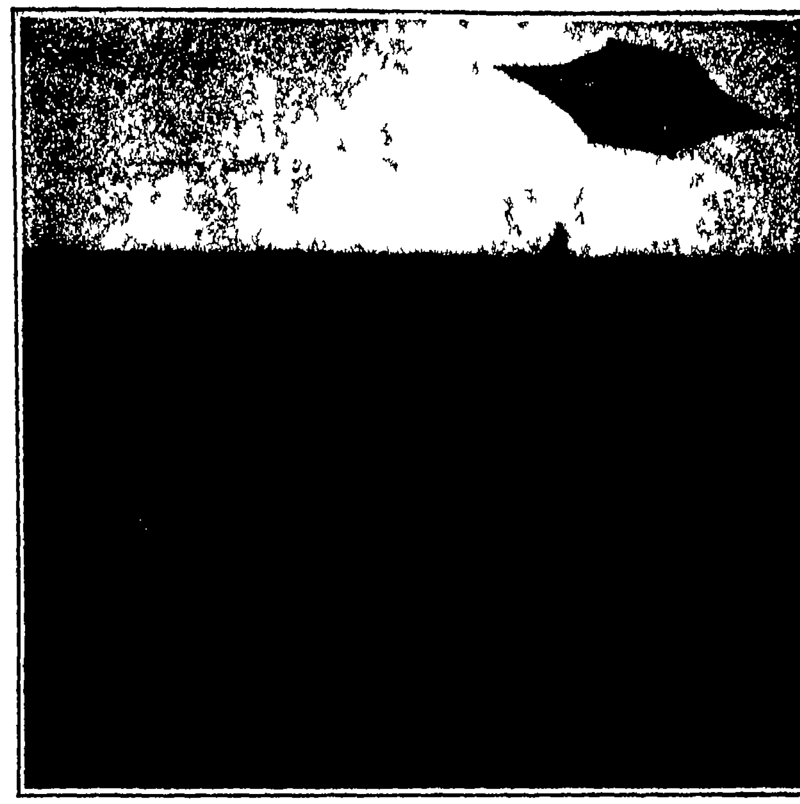
Morning and Evening Stars

The morning and evening stars for any day in the year may be ascertained by inspection of the plot of the terrestrial planets.

(Concluded on page 76)



French officer verifying the identity of a carrier pigeon

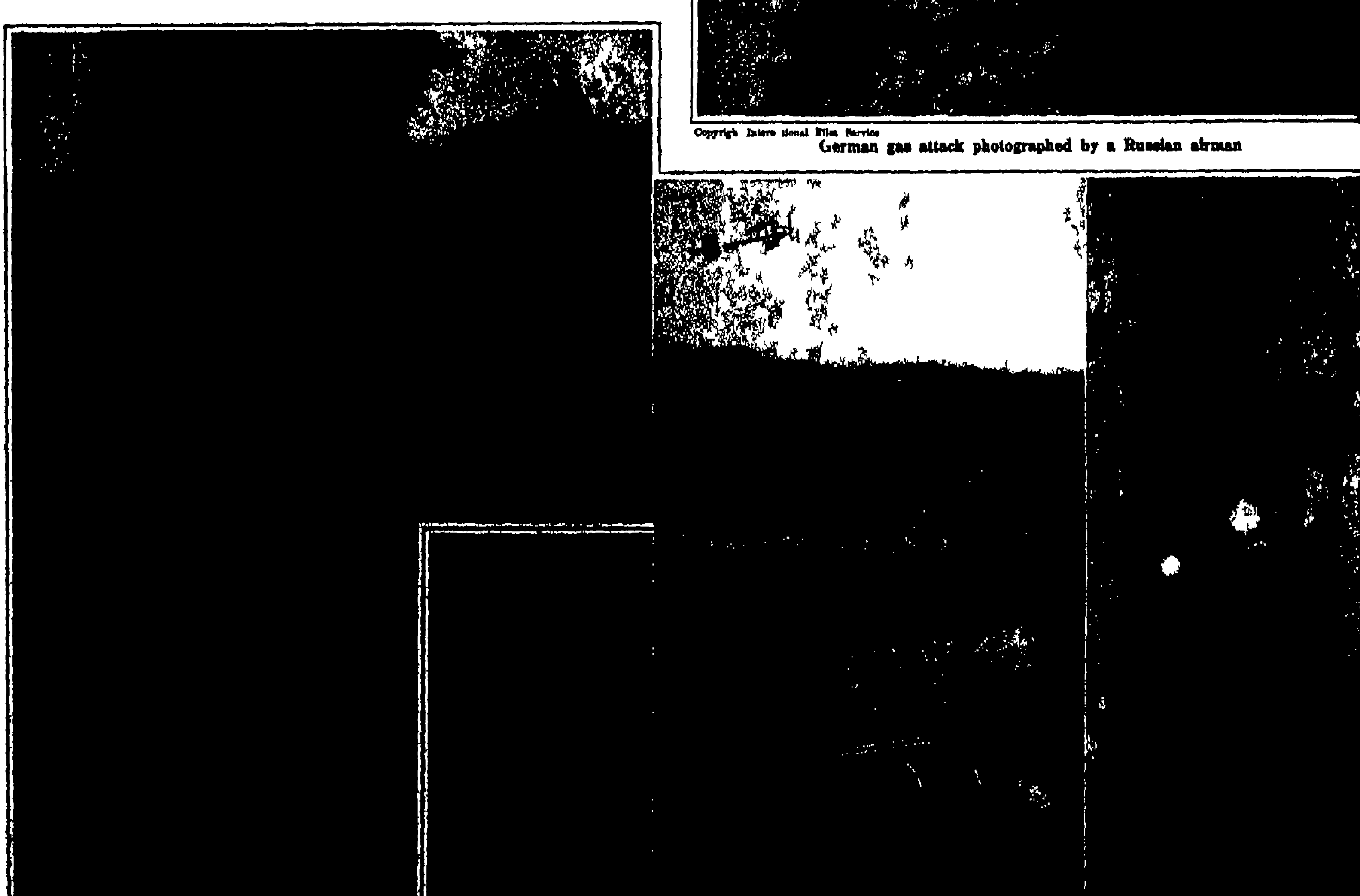


Preparing to photograph the German trenches with a kite camera

French 75 mm. field piece mounted for use against aeroplanes

Copyright International Film Service

German gas attack photographed by a Russian airman



Photographs by Medem Photo Service

Bringing the 155-lb. bombs into the trenches — One of the bomb throwers — Target practice on a toy aeroplane — In the underground galleries

ALONG THE BATTLE-FRONT IN FRANCE

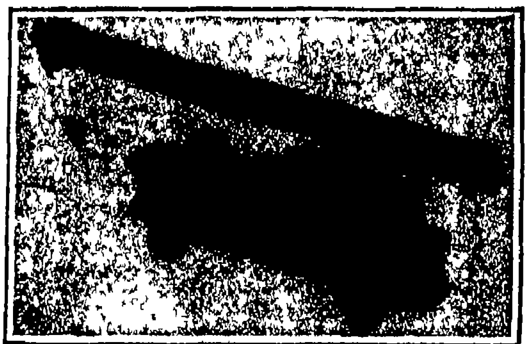
Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Device for Improving Steering Gear of Light Automobiles

PROMPTED by the difficulty of steering a light automobile, especially on rough roads, an American manufacturer has recently introduced a simple device which is claimed to make the cheapest motor car steer like a high priced car equipped with an irreversible steering gear.

Briefly the device may be described as two strong, reciprocating coil springs slipped over the tie rod and held in place by a clamp that fastens to the front axle. The springs absorb every jerk on the wheels so that the driver can sit back in comfort and disregard the irregularities of the road. The device is applied in a few moments time with a wrench. It does away with the necessity of tightly gripping the steering wheel of cheap cars when driving, and keeps the wheels in the road by righting them automatically the instant they strike uneven spots or obstructions of any kind. In a recent demonstration a car equipped with the device was driven at high speed around the corner of a city street and the driver released the steering wheel. Instead of running into the curb the front wheels were automatically righted and the car continued down the side street in a straight course.



Steering device for low priced cars, showing method of application

The Pallograph—An Instrument for Recording Vibrations of Vessels

THE only pallograph in America, and, indeed, one of but two or three in existence has just been completed by Elmer A. Sperry of Brooklyn, N. Y. for the use of the U. S. Navy engineers at the model basin Washington, D. C., in connection with their investigation of vibration of ships.

Briefly the pallograph is an instrument which simultaneously records vertical and horizontal transverse vibrations, and while the instrument is primarily intended for use aboard ships it may be used to trace vibrations or oscillations of any character to their primal source.

The Sperry pallograph embodies a number of substantial improvements over that developed by Dr. Schlick of Hamburg, Germany, possibly the most important being mechanism which so regulates its period that it will not come into synchronism with any harmonic of the ship's motion. Of equal importance is the introduction of pencils for indicating revolutions of the ship's shafts and a time marker indicating seconds. Records are made on a 5" paper strip, moved upwardly at constant speed by a small motor, the speed of travel being variable from 1⅛" down to ⅝" per second, as required. It will be readily understood that vibrations of high frequency or of considerable amplitude should be recorded on a rapidly moving strip, so that the wavy lines of the diagram will be widely separated for thorough analysis—indeed, it is even frequently necessary to enlarge certain sections so that conclusions as to the causes of the vibrations may be determined with absolute certainty.

When the pallograph is in operation the pendulum appears to oscillate and vibrate rapidly whereas in reality it is standing absolutely still and the pallograph structure is moving in unison with the body on which it rests.

The general dimensions of the apparatus are 24" long 14" wide and 20" high the weight is approximately ninety pounds.

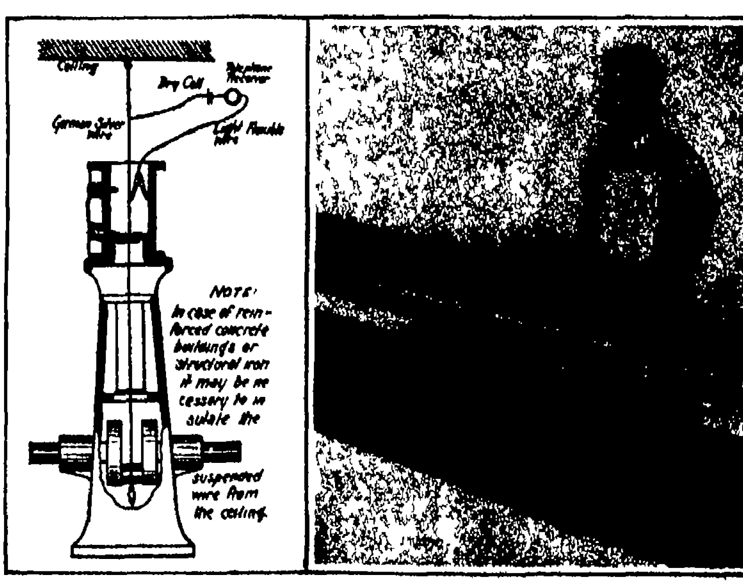
An instrument for recording the vibrations of steamships

Increasing Accuracy of Calipers by Using Telephone Receivers

BY the application of an ordinary telephone receiver and dry cell to a pair of calipers it is possible to gage machine work with an accuracy greatly exceeding that attained by using the ordinary calipers alone.

In the accompanying illustrations are shown two methods of employing electricity for gaging purposes. The first illustration represents a cross sectional view of an upright engine through the center of which passes a plumb line of German silver wire hung from the ceiling. If the ceiling is of metal and is grounded, the wire must be insulated. The wire forms one side of the circuit which includes an ordinary telephone receiver and a single cell of battery, while the other side of the circuit leads to the calipers. By passing the caliper down through the cylinder of the engine, touching either the cylinder wall or the wire with one of the legs of the calipers and attempting to bridge between the wall and the wire, it becomes possible to determine whether or not the cylinder is bored out to the required size and whether it is of an even diameter throughout.

The foregoing method is somewhat crude. A much better procedure is to insulate both legs of the calipers from each other thus enabling the German silver wire to be dispensed with entirely. The calipers, thus insulated can be lowered down into a cylinder more conveniently, in gaging the bore. When the diameter of the bore is of the same or greater size than the caliper adjustment a click is heard in the telephone receiver, caused by the closing of the circuit through the part that is being gaged.



Two methods of using a telephone receiver and dry cell in connection with caliper gaging

In the second illustration is depicted the method of using electricity for gaging machine work held in a lathe. If an ordinary pair of calipers is being used, a piece of cigarette paper is placed between one leg of the calipers and the metal work, as shown. The insulated leg is held tight against the work while the other leg is employed for gaging. While the work is of the same size or larger than the caliper adjustment, a click is heard in the telephone receiver.

It will be appreciated that these methods are inelaborate and that they offer much opportunity for improvement if the user wishes to go to the trouble of making a more practical gage.

New Rules of Practice

NEW rules of practice before the United States Patent Office became effective January 1st.

The new rules, while elaborate and technical, make for brevity, simplicity, speed and efficiency.

A year ago Commissioner Ewing, of the Patent Office, appointed a committee, of which R. F. Whitehead, assistant commissioner of patents, was the chairman, and Walter F. Rogers of Washington, former president of the Patent Bar Association was a member, to make a thorough revision of the rules of practice. No general revision of the rules had been made for several years and in the view of Commissioner Ewing, it was desirable, even necessary that the work should be done in the interest of inventors and in the interest of the Government.

After ten months of work the results were submitted to patent experts and patent attorneys throughout the country, with the request that they give the Patent Office the benefit of their suggestions in respect of the proposed changes. Hundreds of suggestions were made and all have been carefully analysed and many of them incorporated in the new rules. This was the first time in the history of the Patent Office that practitioners and the inventing public ever were consulted concerning the formation of the rules and practices.

"Safety First" Tea Kettle

A NEW tea kettle is supplied with an extra opening in the top through which it may be filled without the inconvenience and danger of being scalded by the steam generated when cold water is poured into the hot kettle. The second opening is a small one in front of the bail and is protected by a hinged swing cover, which may be operated by the thumb while the kettle is being held by the bail under the faucet.

"Time-Study Watch"

THE stop watch, which was first made as a race track accessory and was used for a long time exclusively for timing speed contests, has now entered into very extensive use in the industrial world for the purpose of arriving at the cost and time of various manufacturing operations. For this purpose the ordinary decimal dial watch seemed to answer the demand, but after the time of a specified task has been taken, a more or less difficult computation is required to reduce the observation to output per hour or day as may be desired. A new instrument, by which these results are arrived at instantly and shown in plain figures on the face of the timepiece, is now being introduced into such establishments where it is the custom to secure detailed data concerning production costs. The new "time-study watch" has a computed dial, being divided into tenths and hundredths of minutes, and in addition the dial contains distinctly legible figures spaced two hundredths of a minute apart that indicate, at any point of elapsed time, exactly what the corresponding output per hour is. Thus, if it requires 76 of a minute to perform one operation, as shown by the large hand, the reading 78.9 directly under it is the corresponding output per hour. An employee realizing that the watch is being held on him will prolong the operation at hand by some wasteful and unnecessary movements. By the aid of this instrument the net time required for the work may be easily arrived at. Having made an observation of the time consumed, a second checking is made and the watch is stopped during the fractions of the second which the employee "loafs." The reading on the dial will give the actual time consumed in useful energy, and the difference between the two readings is the time wasted in that particular cycle of work. The movement of the watch is controlled by a slide on the outside rim of the case convenient to the stem. "Industrial engineers" are finding the "time-study watch" a great factor in their work.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

SHIRT.—G H. NICHOLAS, 354 W 181st St., New York, N Y This invention relates to men's shirts, especially adapted for use by laborers, machinists and the like, although, if desired, certain features may be embodied in negligée shirts of the better grade. The invention improves the design of the shirts so as to be more durable, attractive in appearance and comparatively simple and inexpensive to make.

BUTTON.—R. C BRADLEY Address Victor C Barringer, Monroe, La. An object here is to provide a button which can be readily covered by a piece of cloth without the necessity of using a special machine for covering the same. A further object is to provide a button in which the assembling of the parts stretches the cloth covering tightly into place.

Electrical Devices

ELECTRIC CLOCK.—F HARDISTY, Buck Creek, Ind. An object of this invention is to provide a clock which is run by a small amount of current and which therefore consumes very little energy A further object is to provide a novel form of striking mechanism which is also actuated electrically.

AUTOMATIC MALLET OR PLUGGER.—G CROSTON, Hoquiam, Wash The invention has for an object the provision of an electro-magnetically operated hammer or plugger having an improved form of switch whereby the circuit of the coils can be locked open or closed or whereby the operator can control the circuit manually

Of Interest to Farmers

COTTON COMPRESS.—W HILL, Alexandria, La The inventor provides a machine with means for employing relatively quick acting and slow-acting power and with means for taking up the lost motion of the said slow-acting power provides means for shortening the time required for the complete operation of the compress, and simplifies the mechanical construction of the compress.

SELF DUMPING FRESNO SCRAPER.—J F BOONE, Long Lake, N Y The invention relates more particularly to Fresno scrapers or scrapers for handling loose dirt, such as in leveling ground previously plowed when the land is about to be irrigated, as distinguished from slip scrapers such as used on reclamation projects to cut into the solid earth and carry it off

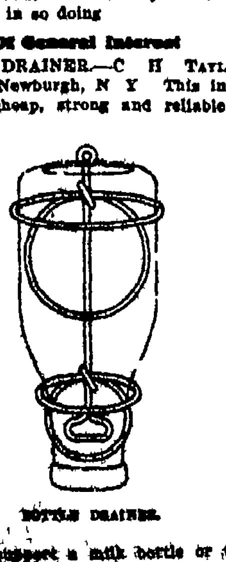
PEANUT THRESHING MACHINE.—C R. LIVERMON, Roxobel N C This invention provides a device by means of which the peanuts may be stripped from the vines and delivered in a perfect condition. It provides a device which will not tend to clog up, but in which the vines are so treated as to be kept from clogging up the machine and thereby delaying the operation of the device.

DISK CULTIVATOR.—J Herdlein, De Soto, Mo This improvement provides a cultivator capable of adjustment as to the depth of the cut of the disks, and as to the quantity of soil thrown by the disks, and as to the lateral position of the disks, and the width of the rows, and wherein the cultivator is especially designed for hard ground, and for destroying weeds, and for leaving a fine mulch on the surface.

COW'S TAIL HOLDER.—R MCGAHEY, Walla Walla, Wash The invention relates to means for preventing a cow from switching her tail while being milked, and one of the main objects thereof is to provide a device which may be instantly placed into and removed from operative position by the person milking the cow, and without the necessity of soiling his or her hands in so doing

Of General Interest

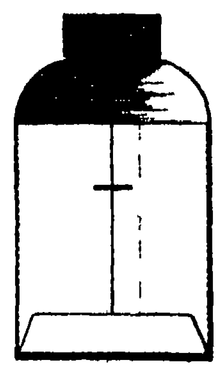
BOTTLE DRAINER.—C H TAYLOR, 80 Beacon St., Newburgh, N Y This invention provides a cheap, strong and reliable device



BOTTLE DRAINER.

adapted to support a milk bottle or the like in such position that it may thoroughly drain with the mouth portion open or free, and whereby the bottle may be filled in position to be collected by the milkman if desired. While especially designed for use in connection with milk bottles, the device is not so limited in use.

ENVELOP.—F L. TOUPAL, 1410 Lowe Ave, Chicago Heights, Ill This invention relates to envelops and more particularly to closures therefor It provides a novel form of flap closure for retaining the envelop sealed against accidental opening thereof, which may be



ENVELOP

opened without mutilating the same It provides an envelop of this character which is simple in construction thus reducing the cost of manufacture to a minimum and which is effective in carrying out the purpose for which it is designed.

PROCESS OF OIL EXTRACTION FROM SEED KERNELS.—W McC NEALE 479 W Washington St., Greenville S C The objects of this invention are attained by treating the crushed seed kernels for moisture and then subjecting the so-crushed seed kernels to a hot current of predetermined moisture and temperature the said seeds being prevented from agglomeration when subjected to the current so as to expose a maximum surface of contact to said current.

NON-GLARE DEVICE FOR THE EYES.—J C F MB VAY, 707 Pacific Ave Atlantic City, N J This invention relates to a non glare device designed to be worn by persons to prevent the sunlight glare from buildings, side walks, snow and the like from injuriously affecting the eyes The device is comparatively simple and inexpensive to manufacture.

UTILIZATION OF PEAT.—N TESTRUP 6 Broad Street Place, London, E C England T RIGBY, Station Hotel, Dumfries, Scotland, and O SÖDERLUND, Fairlawn," Clapham Park London, S W, England. According to this invention the peat, after wet carbonization and removal of the bulk of its liquid matter by internally transmitted pressure as on a filter press has a further quantity of water removed from it either by treatment in a hand or like press, or by exposing it to hot products of combustion from apparatus employed on the process, part of the partially dried material being supplied to ammonia recovery gas producers and the remainder converted into gaseous fuel product

CHECK UP HOOK.—W J FRICKE 2011 Yolo Ave, Berkeley, Cal This invention has reference to devices known largely as check up hooks, in the use of which a load either suspended, or connected to be towed or hauled, is adapted to be released by the release or casting off of a pivoted hook by which the load is connected to the draft power or suspension means.

BAG SPLITTER.—W J CULLEN, Room 1406, 30 Church St. New York, N Y This invention relates to devices for separating the contents of a bag into two or more parts and particularly to what is known as a bag splitter, and has for an object the provision of an improved construction which accurately splits the bag into the desired number of parts with a minimum effort.

BOTTLE CAP.—P D BELLES, 339 E 124th St., New York, N Y This invention has reference to bottles and jars and has particular reference to closures for such devices Among the objects of the invention is the provision of a temporary closure for a milk bottle or other container from which the liquid contents are to be dispensed periodically

PENCILING GUIDE.—W E. AYCOCK, Aycock, Fla This guide is for use in painting or penciling the bases of the grooves between the outstanding faces of scratch joint brick work and particularly grooved wood surfaces in imitation of such brick work, the object being to provide a guide for a paint brush of any suitable character by which the faces of the grooves may be well and quickly painted without danger of painting or smearing with paint the sides of the grooves which are the edges of the outstanding faces in imitation of brick.

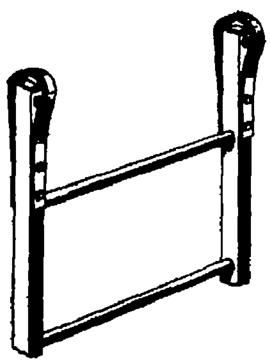
PENCIL HOLDER.—M F SEXTON, Stuart, Iowa This invention has reference to means for holding a pencil, and has reference more particularly to a pencil holder adapted to be received on a person's finger, which comprises a ring having means adapted to receive and hold a pencil or a penholder

SHELVING.—A. T. WINDQUIST, 1617 Morgan St., Aberdeen, Wash. This invention provides shelving of sheet metal, suitable for use in stores and shops, or for holding books or the like, and of sectional character, capable of being set up or knocked down, and adjustable for varying needs, and wherein the mechanism is such that the shelving may be quickly set up or taken down, may be packed in compact form when knocked down and which will be of handsome appearance when set up

Hardware and Tools

WRENCH.—T HAND, P O Box 663, New Haven, Conn The present invention has reference generally to wrenches and more particularly to a wrench having something of the nature of a combination tool in that it is particularly adaptable to round surfaces such as pipes and also to polygonal shaped work

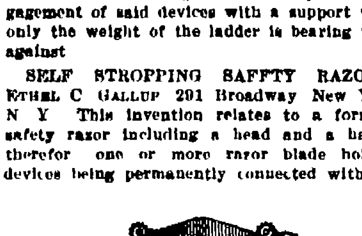
LADDER ATTACHMENT.—F L TOUPAL 1410 Lowe Ave, Chicago Heights Ill This invention is an improvement in ladders and has particular reference to a device carried thereby and adapted to engage a wall or other support to retain the ladder in position The device will not materially damage the support



LADDER ATTACHMENT

against which the ladder is leaning and at the same time will effectively prevent slipping of the ladder while in use The fastening device has shields or guards which prevent engagement of said devices with a support when only the weight of the ladder is bearing there against

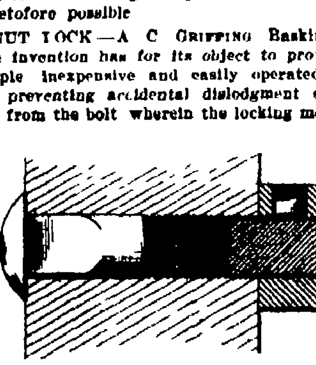
SELF STROPPING SAFETY RAZOR.—ETHEL C GALLUP 291 Broadway New York N Y This invention relates to a form of safety razor including a head and a handle therefor one or more razor blade holding devices being permanently connected with the



SELF STROPPING RAZOR

head and adjustable thereon so as to position a blade or blades for either shaving or stropping purposes It improves safety razors so as to make them more readily adaptable for either shaving or stropping purposes without material interchange of parts, than has been heretofore possible

NUT LOCK.—A C GRIFFING Baskin La The invention has for its object to provide a simple inexpensive and easily operated lock for preventing accidental dislodgment of the nut from the bolt wherein the locking mechan



NUT LOCK

ism is supported by the nut, and coöperates with the bolt to prevent accidental reverse rotation of the nut on the bolt but arranged to permit the lock to be released to permit reverse movement of the nut

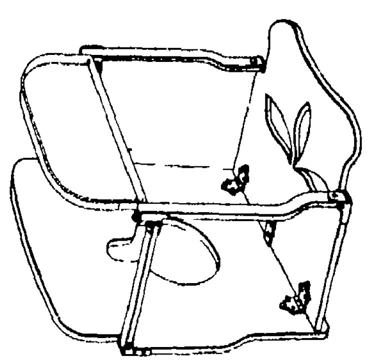
Heating and Lighting

LAMP AND LAMP SUPPORT.—C KAUFMANN, care of Kaufmann Williams Lamp Co Santa Ana, Cal The invention relates more particularly to lamps and supports thereof especially adapted for use in connection with automobiles, motorcycles canoes launches, and the like the object being to provide an arrangement wherein the lamp proper may be removed from its support and utilized as a spot light in case of trouble

AUTOMATIC SAFETY VALVE.—G F WEHMANN, 330 Manhattan Ave, Brooklyn N Y., N Y, and L G WULBERN Charleston S. C. In the present patent, the invention has reference to safety valves, particularly for gas pipes, and the main object thereof is the provision of such safety valves which automatically close when the surrounding atmosphere reaches a predetermined point

Household Utilities

CHILD'S SEAT.—W H GIBSON, 170 Rugby Ave Rochester N Y This invention pertains to a toilet seat for a child and provides such a seat as is foldable easily portable and adapted for instant and positive connection



CHILD'S SEAT

with a conventional toilet seat and provides such seats as are rigid in use, light and compact composed of but few parts not likely to get out of order to require repair, and comparatively inexpensive

COOKING UTENSIL.—EMMA R. MEYER, 151 W 145th St New York N Y This invention provides a utensil which has a lid substantially close fitting and adapted to be held in position so that when in one position the steam will be practically held within the utensil and in another position openings are provided through which the water or juices may be drained off, the lid supporting and retaining means insuring that the operator cannot be scalded or burned and, whereby the desire may be manipulated for draining off the water by the use of one hand only

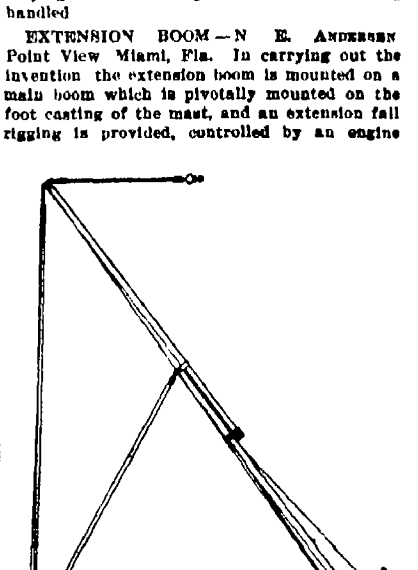
DOMESTIC UTENSIL.—J N JACKSON, Millersville Ill. The main object here is to provide a frame or support for either of a plurality of attachments whereby the device may be used for various purposes By means of such attachments the device is adapted for use as a press for wine fruit or lard as a meat or lard chopper as a sausage stuffer etc., without any alteration in the frame structure

Machines and Mechanical Devices

VACUUM PUMP.—C N SNOWDEN Santa Cecilia Guantanamo Cuba The invention refers to vacuum pumps of the reciprocating type and has reference more particularly to pumps used in connection with sugar refining The object is to provide an efficient pump whereby the said pump during its stroke can form a plurality of independent vacuums of predetermined pressure

CLOTHES LINE HANDLING AND MEASURING MACHINE.—J A JOHNSON 16 Dunham Place Brooklyn N Y This inventor provides means for mechanically controlling the delivery of rope from a supply coil to a cutting station provides means for preventing the recession of the severed ends of the rope provides means for registering the length of the rope delivered past the cutting station provides means for delivering ropes of different characters from independent supplies without mutual interference and avoids fraying or abraiding the material being handled

EXTENSION BOOM.—N E. ANDERSEN Point View Miami, Fla. In carrying out the invention the extension boom is mounted on a main boom which is pivotally mounted on the foot casting of the mast, and an extension fall rigging is provided, controlled by an engine



EXTENSION BOOM

drum, together with safety devices in the way of improved guiding means for the extension boom, locking devices to hold the extension boom in the adjusted position and a support

for the extension boom when withdrawn entirely from the extended position

PUMP—F Foley, Gillett, Ark The invention provides a pump having a double piston or plunger together with mechanism for operating the pistons or plungers in opposite directions and wherein a particular form of piston or plunger is provided, offering a minimum resistance to the upflow of the water on the downward stroke of the piston and a maximum of lifting power on the upstroke

CLUTCH MECHANISM—F D Roberts care of The Puget Sound Iron and Steel Works, Tacoma, Wash In this instance the improvement has for its object the provision of a clutch mechanism which will reduce to a minimum the end thrust and which by the means provided will efficiently lubricate the wearing surfaces to prevent an undue generation of heat.

STRAP AND LINE REEL—B C Skinner, Dunedin Fla This invention relates to reels for holding box strapping wire, rope and other stock and has to deal more particularly with a brake or stop for abruptly stopping the rotation of the reel when the desired amount of stock is drawn off so as to prevent the stock from unwinding and becoming tangled

WORK FEEDING MECHANISM—H A. Griffiths, 22 Francis road Edgbaston, Birmingham England This invention comprises the combination with a slide of a pair of racks, and a pawl and stop in conjunction with each rack, the arrangement being such that while the intermittent movements of the slide are being produced in one direction by the action of one of the pawls on one of the racks the stop in conjunction with the other rack is operating to bring the slide to rest in the correct position at the end of each of such movements

CLAM DIGGER AND FISHING MACHINE—L. R Gage Hoquiam, Wash Among the objects of the invention is to provide a peculiar construction of dredging apparatus with means for adjusting the same vertically with respect to the supporting frame and having associated therewith an endless carrier or elevator for gathering and delivering the clams loosened from the sand by said dredging devices

SAFETY GAGE GLASS—G Ernst, 176 Ferry St. Newark, N J The inventor provides socket pieces of peculiar construction into which the ends of the glass proper are fitted out of contact with the structure of the sockets, a tubular guard being provided surrounding the gage glass and connected rigidly to said socket pieces

FIRE ESCAPE—A F Fornelius, 12 Spring St, Athenia, N J This invention provides means for controlling the speed of descent of a person by means of the device, and provides means for accommodating the device to the weight of the person It also provides means for re-winding the cable after use in order to allow of the use of the device by more than one person

MACHINE FOR RENAPPING AND REFINISHING CLOTH—E J Dunkley, 133 Elm St. Hackensack, N J In the present patent the invention has reference to a machine for renapping and refinishing worn cloth, and is especially adapted for use by tailors and cleaners whereby woolen garments can at the worn spots be so treated as to give the garment a new appearance

CARBID HOLDER.—W L. Cash and I B Crown, Graham Ky The invention provides a holder especially adapted for holding cans of calcium carbid wherein mechanism is provided for supporting the can in a position such that it can be tilted to permit the removal of a portion of the contents without any great physical exertion and wherein the mechanism may be quickly attached to or detached from the can

SYRINGE—R B Thurman Sparta, Tenn This syringe is especially adapted for dentists use for flushing the oral cavity and for dislodging foreign matter in cavities of the teeth during the process of dental work wherein the syringe is provided with automatic mechanism for draining the syringe

Musical Devices

MUSIC HOLDER—A M Browne Address McVea Young Pascagoula Miss The inventor provides a music holder adapted to be used as an envelope or portfolio for carrying sheets of music, and having means for supporting the sheets against accidental displacement in view of the musician while he is reading them

Prime Movers and Their Accessories

PRIMER—C Kaufmann care of Kaufmann Williams Lamp Co Santa Ana Cal This mechanism is for use in connection with explosion engines using distillate gasoline, alcohol or the like, and arranged between the carbureter and the engine for assisting in the evaporation of the fuel when starting the engine, and wherein other mechanism is provided for permitting the use of fuel evaporation at a lower temperature than the ordinary fuel for starting the engine

CURRENT MOTOR.—B T Sams and W H Hout, Warrensburg Mo. In this case the invention relates to current motors and has reference more particularly to a water wheel in the shape of a spiral formed by a cone surface and mounted to float in a water current at a suitable angle to the direction of the current with the cone surface of the spiral The invention provides a current motor which is adapted to support itself on the fluid by which it is actuated

Railways and Their Accessories

AUTOMATIC TRAIN STOP DEVICE—T T Chalones, 507 W 109th St New York N Y The invention relates particularly to an automatic train stop adapted to be carried by the train and arranged to engage danger arms positioned along the track whereby the stop mechanism will be operated for opening the air brake system of the train when the danger arms have been engaged

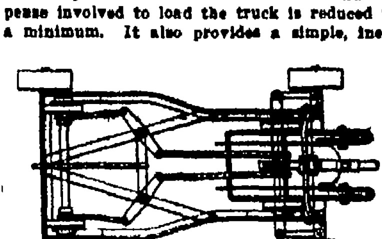
Pertaining to Vehicles

FLEXIBLE COUPLING—A. N Clarson, Sheridan, Ill The coupling is constructed with an arm secured to one of the shafts which is rotated by members with which it is engaged at its ends the members being secured to the outer ends of levers fulcrumed to a disk secured to the driving shaft and with the inner ends of the levers connected by a link.

ROBE FOR AUTOMOBILES—H S Z Adler Box 466 Portchester N Y This robe protects the lower portion of the person or persons seated on the front seat of the automobile against the inclemency of the weather at the same time permitting the driver to freely utilize the feet for the manipulation of the pedals and to use the hands for manipulating the steering wheel or the hand lever or levers for controlling the emergency brake, reversing mechanism or the like

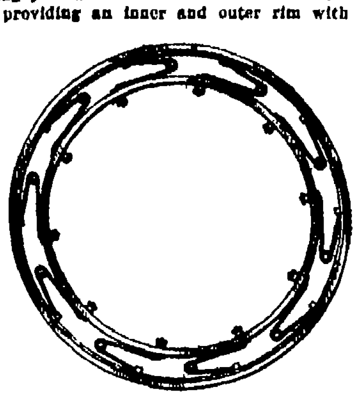
BOLT BEARING—J L. Beane, Le Grand Iowa This improvement is in rodless end gates for wagons and provides a mechanism for securing an end gate in place on a wagon, without the use of the usual rod and wherein the gate may be locked or released without removing the locking means from the gate

TRUCK—I McCoon, Windsor Locks, Conn This invention provides a manually operated truck by means of which the time and expense involved to load the truck is reduced to a minimum. It also provides a simple, inexpensive, strong and convenient manually operated truck, in which the platform for loads is made to move bodily and in which the platform can be maintained in its extreme position without any effort.



MANUALLY OPERATED TRUCK

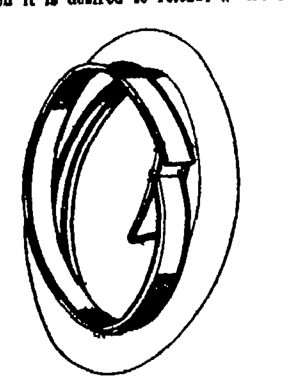
VEHICLE WHEEL—A Gibeault, 411 Carpenter Ave, Iron Mountain Mich This invention relates more particularly to a novel tire construction whereby the necessity for using pneumatic tires is obviated It consists in providing an inner and outer rim with a plurality of spring members interposed therebetween and secured thereto in a novel manner The primary object is the provision of a vehicle wheel which is light durable and calculated to effectively cushion the vehicle and eliminate shocks and jars thereto.



VEHICLE WHEEL

SUSPENSION WHEEL—W S. Watson, care of Watson Suspension Wheel Co, 718 719 Hippodrome Bldg Cleveland O An object in this case is the provision of a tension wheel having steel rims and spokes the latter being provided with hub connections that may be used with the metal flanges or hub housing of any ordinary wooden spoke wheel used on automobiles.

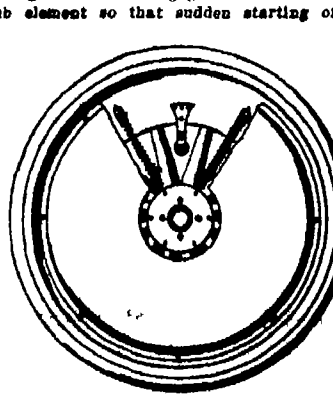
OPERATING DEVICE FOR SPLIT WHEEL RIMS—D J Raymond Crandon Wis This invention relates generally to split wheel rims, and more particularly to an implement or means in connection therewith, and forming a permanent part thereof, for reducing the split rim when it is desired to release a tire therefrom said implement and means acting, when in closed position as a brace for supporting the free ends of the rim on opposite sides of the gap in operative position



OPERATING DEVICE FOR SPLIT WHEEL RIMS

MOUNTING FOR VELOCIPEDE PUMPS—G A. Magin, 53 Lancaster St., Albany N Y The invention relates to mountings for velocipede pumps that is, to means for supporting the pump within the tubular frame of the machine in such a manner that the pump is carried safely and held firmly in position while the machine is in use, but is also readily accessible and easy to remove for the purpose of inflating the tires of the velocipede

VEHICLE WHEEL.—E H Sipes, Tripp, S D This invention relates more particularly to that type commonly known as spring wheels, and adapted for use on automobiles and other vehicles It provides an outer rim element having a frictional engagement with the inner hub element so that sudden starting of the latter will cause a slight relative movement therebetween and impart a more gradual rotation to said outer rim element, means being provided for limiting said relative movement whereby the springs and connections therefor will not be subjected to undue strain.



VEHICLE WHEEL

VEHICLE FRAME SUSPENSION AND SHOCK ABSORBER.—C Simon, 34 W 18th St, New York, N Y This inventor provides a frame suspension which can be as easily applied to newly constructed motor vehicles as to motor vehicles already in use as the attachment proper is applicable directly between one end of the spring and the frame of the vehicle without any alteration to any part of the vehicle

WORM DRIVES FOR AUTOMOBILES—E S Stitch 2128 Mt Vernon St. Philadelphia, Pa The present invention has reference to improvements in differential driving mechanism, and has for an object the provision of an improved construction wherein a worm will act as a power member without producing undesired end or side thrusts

VEHICLE WHEEL—N Cornfield, 2 Columbus Circle New York N Y This invention has reference to vehicle wheels the more particular purpose being to provide a wheel with springs suitably arranged for taking up the play of the axle and performing generally the office of a pneumatic tire Mr Cornfield has invented another vehicle wheel, and the objects of the improvement are to maintain the alinement of separately operating elements of the wheel to minimize the friction between the relatively moving parts and to strengthen and simplify the construction

BUFFER.—R C Rogers 461 Park Ave, Brooklyn N Y An object here is to provide a buffer which may be used upon a door at any point and a door of any kind with a minimum amount of work in applying the same the first time and practically no work in renewing the same

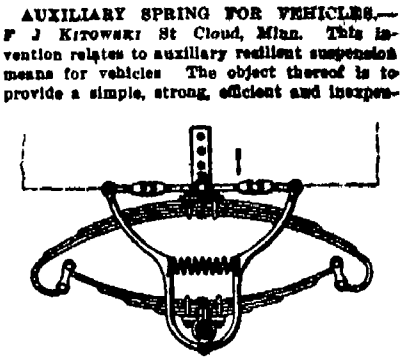
RESILIENT WHEEL.—J F Nettle, P O Box 1057, Butte Mont This invention relates to improvements in resilient wheels, and has for an object to provide a wheel which retains the characteristics of a wheel provided with a pneumatic tire while presenting means to the earth or road-bed which cannot be punctured or readily injured.

PNEUMATIC CUSHION.—L A. Lake, 3842 Hill Ave., Bronx, New York N Y In the present patent the invention has reference to cushioning devices and particularly to what are sometimes called shock absorbers for vehicles, and has for an object the provision of an improved construction that utilizes air as the cushion medium.

CHAIN TIGHTENING DEVICE.—E. J. Benson, Blackfoot, Idaho. The invention provides means whereby a chain of the non-skid type may be tightened around a portion of the periphery of a wheel as in cases where the wheel is partially submerged in mud to such an extent as to render the placing of the chain entirely around the wheel impossible.

SPRING SUSPENSION GEAR FOR MOTOR CARS AND OTHER VEHICLES.—J A. Shearer, Prospect, South Australia, Australia. The invention relates to the suspension or mounting of the frame of a motor car or other vehicle upon its axles by means of links connected with each axle and pivoted to said frame and adapted to be moved against the action of the spring or springs, when said axle rises relatively to the frame, so as to absorb the shock or jar caused by the passage over rough roads or over irregularities or obstacles.

AUXILIARY SPRING FOR VEHICLES.—F J Kitowski St Cloud, Minn. This invention relates to auxiliary resilient suspension means for vehicles The object thereof is to provide a simple, strong, efficient and inexpensive auxiliary suspension means which forms a protector for the main spring used in connection with vehicles and which will also serve as a shock absorber



AUXILIARY SPRING FOR VEHICLES

ANTISKID DEVICE.—G T Heckmann, 535 Merchants Laclede Bldg, 4th and Olive Sts., St. Louis, Mo. This invention refers more particularly to the type of anti-skid devices for tires involving the use of chains arranged to be secured transversely of a tire by clamp means engaging the spokes It provides a clamp in which the clamp screw to tighten or loosen the jaws of the clamp is prevented from turning one clamp jaw relatively to another, whereby to facilitate the tightening and loosening of the clamp by the use of one hand only

Pertaining to Warfare

SEMISUBMERSIBLE WAR SHIPS.—S D Simmons and H Amling 4228 Park Ave Bronx, N Y N Y This invention relates to naval craft and in certain aspects is of the Monitor type, in that only the top of the hull and the gun turret are visible. The invention has for an object to improve the construction of the hull so as to be mine and shell proof, due to its special shape and the thickness of the walls of the hull

Designs

DESIGN FOR A LAMP SHADE—G C Lynch, 353 4th Ave, New York, N Y In this ornamental design for a lamp shade a side elevation shows the shade ornamented in a neat and attractive border and division arrangement of flowers and leaves

DESIGN FOR A BOTTLE.—A G Carling, 119 W 64th St., New York, N Y In this ornamental design for a bottle the article is shown in three views, a front elevation showing a new design an edge view, and a cross section of the same.

DESIGN FOR A BELL CROWN—F C White, 79 Delaware St., Woodbury, N J This ornamental design for a bell crown is shown by two figures one representing a front elevation, and the other a side elevation.

DESIGN FOR A PHONOGRAPH BOX OR CABINET—L. Markels, 160 William St., New York, N Y In this ornamental design for a phonograph box or cabinet, the article comprises a cabinet of low and almost square formation and of attractive lines.

DESIGN FOR A BODY FOR A PENDANT OR SIMILAR LAMP.—B. Schwartsman, 15 Laight St., New York, N Y This ornamental design for a pendant or similar lamp is No. 48,284. Mr B. Schwartsman has also secured eleven other designs comprising two designs for a back plate for lighting fixtures, Nos. 48,286 and 48,291; two designs for a socket cover for lighting fixtures. Nos. 48,287 and 48,293, two designs for a canopy for lighting fixtures, Nos. 48,292 and 48,294; and five designs for a shower plate for lighting fixtures, Nos. 48,285, 48,288, 48,289, 48,290, and 48,295.

Note.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

New York to Chicago—a Thousand Miles—on a Gallon of Oil—Another World's Record for the Franklin Car

IF YOU were an automobile manufacturer and expected to stay in business for the rest of your life, which would you rather do, play to the unthinking, imitative automobile public, or find out what *type* of car will do the *most* for the *motorist* and build it for the man who has to be *shown?*

One thing that separates the Franklin Car amongst all the fine cars in America is the Franklin system of Direct-Air-Cooling.

And let us say right here that *Air-cooling is making more people think* than any one principle in motor construction today.

Men have got to think about it because of what air-cooling is doing and will do.

The Franklin Direct-Air-Cooled Engine turns more of the fuel into useful power than any other engine.

The test of the Franklin Car by the Worcester Polytechnic Institute in April, 1914, proved that *84.4 per cent. of the power* developed is *delivered to the ground in driving force.*

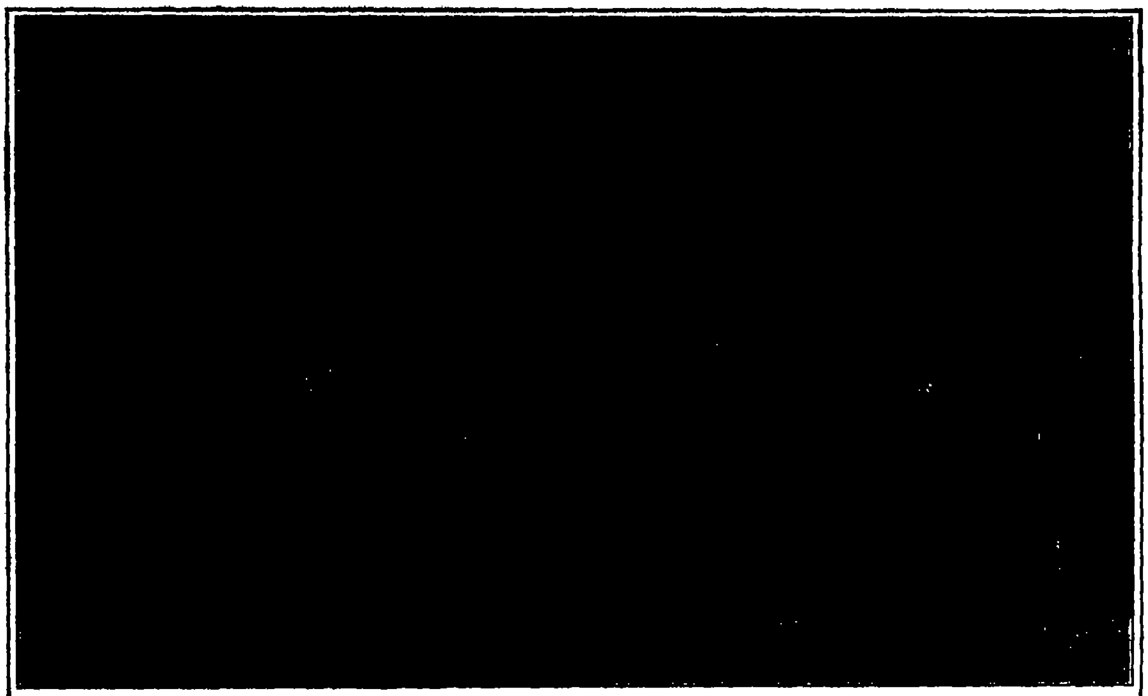
The Franklin Direct-Air-Cooled Engine delivers the highest economy in gasoline.

The National Efficiency Test, on May 1, 1915, *proved the gasoline economy* of the Franklin—when 137 Franklin Cars, in all parts of the country, delivered an average of *32.1 miles on a gallon of gasoline.*

The Franklin Direct-Air-Cooling System does away with useless weights—the radiator, with its weight of water; the water-jackets, the piping, pump and pump accessories, pipe connections, the dead weight of castings and supports to carry these parts. It means less weight on the tires, a saving in drag, in wear, in grind.

The records of Franklin owners in every part of the United States, of *9630 miles to the set of tires,* proves that the saving of weight due to the Franklin System of Direct-Air-Cooling and flexible construction practically *doubles the life of tires.*

The Franklin Direct-Air-Cooled Engine does away with all troubles of freezing and over-heating—no water to freeze—no water to boil.



This Franklin Touring Sedan arrived in Chicago, at six minutes after six o'clock on the morning of November 20, 1915, after a no-stop run from New York City, establishing the world's record of 1046 miles on one gallon of oil. The lubricating system was officially sealed at the start. The Car carried two observers throughout the trip, and the test was conducted from start to finish under the supervision of the Automobile Club of America.

The Franklin Direct-Air-Cooled Engine delivers service twelve months in the year—regardless of climate, locality or weather conditions.

The Franklin Low Gear Run, August 1 to 4, 1915, proved the *perfect freedom of the Franklin Car from heating troubles*—a run of 860 miles from Walla Walla, Washington, to San Francisco, on Low Gear without once stopping the engine.

The new world's record for Oil Economy has just been established by the Franklin Direct-Air-Cooled Engine—*one thousand miles on one gallon of oil.*

The Franklin Direct-Air-Cooling System is *reducing the largest item of expense* in owning a car—the loss of value through wear and tear.

Every motorist can prove this for himself—find out the used-car value of any Franklin Car.

Remember once more, please, that these Franklin achievements have never been duplicated by any car, anywhere.

That the Franklin Direct-Air-Cooled Car is the one type that meets the rapidly growing demand of thoughtful motorists for comfort, economy and reliability, is proved by the fact that Franklin dealers throughout the country have had more orders than they could fill; that we have just closed the biggest year in our history, and that we are compelled to double our facilities for building the Franklin Direct-Air-Cooled Engines.

However much a man may know about motoring and motor cars in general, he never knows what the Franklin Direct-Air-Cooling System adds to the comfort, the pleasure and the safety of motoring *until he drives the Franklin Car himself.*

For the man who is looking for the car that will do the most for him, and wants to be shown—there are just two classes of men to talk to about the Franklin Car: Franklin owners and Franklin dealers.

They know the Franklin. Often they have owned and driven other cars as well. They can give you the facts about the Franklin Direct-Air-Cooled Car in comparison with other cars—a comparison that is growing more and more important to the motorists of this country every day.

FRANKLIN AUTOMOBILE COMPANY
SYRACUSE, N. Y.

Touring Car—$1950, F O B Syracuse, N. Y.
Actual Scale Weight, 2680 Pounds

Morning and Evening Stars for 1916

(Concluded from page 62)

If a straightedge be passed through the earth and the sun at the assigned date, the planets will be divided into two groups, those on the right which rise before the sun and are morning stars, and those on the left which set after the sun and are evening stars Before the dates of superior conjunction Mercury and Venus are morning stars, between superior and inferior conjunction they are evening stars Before conjunction the other planets are evening stars, after conjunction they are morning stars.

TABLE 3. CONJUNCTIONS OF THE PLANETS.

Jan.	6	Venus and Uranus
	17	Mercury and Uranus
Feb	3	Mercury and Uranus
"	13	Venus and Jupiter
Mar	4,	Mercury and Uranus
April	8,	Mercury and Jupiter
May	23	Venus and Saturn
June	22	Venus and Saturn
July	13	Mercury and Venus
"	21	Mercury and Saturn
	26,	Mercury and Neptune
Sept.	5	Venus and Saturn
	13	Venus and Neptune
Dec.	21	Mercury and Mars

TABLE 4 GREAT ELONGATIONS OF MERCURY AND VENUS

Mercury	(E)	Jan. 20	May 12	Sept. 9
	(W)	Mar 1	June 29	Oct. 20
Venus	(E)	April 23	(W)	Sept. 12
Great brilliancy		May 27		Aug. 9

Death of Thomas F Richardson

THOMAS F RICHARDSON an engineer and bridge builder died on December 20th at his home in Rutherford N J, in his sixty first year

Mr Richardson who was born in Woburn, Mass, was identified with a number of important engineering undertakings, prominent among which were the building of the cog wheel railroad to the summit of Pike's Peak, Col the Cañon Diablo bridge of the Santa Fé railroad, the largest bridge on the Mexican Central railroad at Encarnacion, and the Wachusett Dam and Aqueduct Metropolitan Water Works in Massachusetts. He was a member of several engineering societies and fraternal orders.

NEW BOOKS, ETC.

YOUR BABY A Guide for Young Mothers. By Edith B Lowry, M D Chicago Forbes & Company, 1915. 12mo., 254 pp Price, $1 net.

Dr Lowry's popular handbooks on hygiene are widely and favorably known Her latest is addressed to the prospective mother and the young mother, and tells everything that is essential to the health and happiness of both mother and child The most approved methods for the care of the baby are fully presented in the author's common sense way Feeding clothing, exercise, sleep and training are all covered, and if the knowledge of the book were universally applied we should no longer be faced with the appalling fact that nearly half the children born into the world die before they are twelve months old

THE LOG OF THE ARK By Noah. Excavated by I L Gordon and A J Frueh New York E. P Dutton & Company, 1915 12mo, 150 pp, illustrated Price, $1 net.

A rollicking record of Captain Noah's historic voyage Even the incessant rains could not dampen the spirits of the navigators and the most reluctant reader cannot but smile at Noah's little difficulties with Mrs. Noah the refrigerating machine the lost flea, and the ichthyosaurus quadricessus

MACHINE DESIGN By Albert W Smith and Guido H Marx. New York John Wiley & Sons, Inc 8vo, 500 pp, illustrated. Price, $3 net.

The demand for this standard work has made necessary a fourth edition, and the authors have availed themselves of the opportunity to revise the text thoroughly and to include the results of recent investigations of machine elements "It is comparatively easy," said Prof John E. Sweet, "to design a good new machine but it is very hard to design a machine that will be good when it is old. To accomplish the latter calls for experience imagination and foresight in the designer, and while no book may take the place of actual practice, the present work supplies in no small degree the necessary mental equipment and develops whatever natural aptitude the student may have to start with.

GAS ENGINE TROUBLES AND INSTALLATION By J B Rathbun, B S C E. Chicago Charles C. Thompson Co., 1916. 8vo; 440 pp.; illustrated Price, $1.

Mr Rathbun has provided a meritorious work of reference for all owners and operators of gas engines, which tells them in unmistakable language how to install, operate, make speedy repairs, and keep their engine running efficiently and economically. The construction

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Inquiry No 9434 Wanted the name and address of a manufacturer of special pins, 1/16 of an inch in diameter and ¼ of an inch long, the pins to be made of bone.

Inquiry No 9435. Wanted the name and address of a manufacturer who can furnish grinding machines for the hollow grinding and finishing of razors. Up-to-date machines wanted

Inquiry No 9436. Wanted the name and address of a manufacturer of rat traps having a receptacle attached into which the rat drops and drowns

Inquiry No 9437 Wanted the name and address of a concern that can make an oil or grease gun. West preferred. Must be able to make in quantities of 10 000

Inquiry No 9438. Wanted the name and address of a manufacturer of light aluminum sheets, small tubing, rods and wire, also aluminum solder

Inquiry No 9439 Wanted the name and address of a manufacturer of a knitting machine which was on the market some years ago. The name of the machine was the Bickford Machine It was a hand knitting machine, weighing about 15 pounds.

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Inquiry No 9442 Wanted the name and address of a manufacturer of a machine for cutting skeins of cotton and wrapping each bundle around the middle with wire. A machine of some such kind is used in the brush trade for wiring and cutting to length the bundles of bristles for paint brushes.

Inquiry No. 9443 Wanted the name and address of manufacturers of fuel oil burners and fire wall equipment, suitable for a maximum quantity of water evaporation in a locomotive firebox of the following dimensions: 3½' between door and flue sheet, 8' between grate level and crown sheet, 5' between side walls

Inquiry No 9444 Wanted the name and address of a manufacturer or patentee of a glass preserving jar made for use with air pumps for creating a vacuum.

Inquiry No 9445. Wanted the name and address of a manufacturer who can make a combination pencil holder and point protector

Inquiry No 9446. Wanted the name and address of a manufacturer who can supply machinery for automatically wrapping cigars in thin imported tissue paper having the ends tightly wound and curled. Would consider purchase of machines or patent rights.

Inquiry No 9447 Wanted to buy patented article which is needed in every home, with a possible view to manufacturing and distributing

Inquiry No 9448 Wanted to get in touch with manufacturers who can make small gasoline motors and parts thereof. Must be able to handle considerable orders with expedition.

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Inquiry No. 9450. Wanted the name and address of a manufacturer who can build a light simple motor for light automobiles and for portable farm work.

Inquiry No. 9451 Wanted the name and address of a manufacturer of machinery for making [illegible].

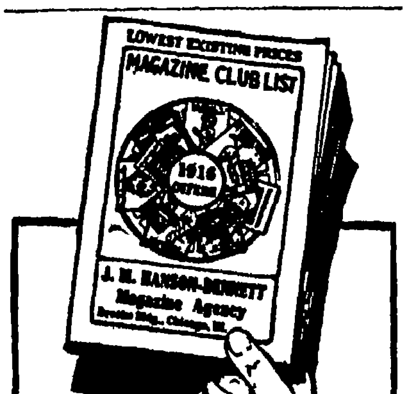
Inquiry No. 9452. Wanted the name and address of a manufacturer making machinery for the extraction of Tannic Acid from the Mangrove plant.

Inquiry No. 9453. Wanted the name and address of a maker of a machine for [illegible]; also machine for cutting, [illegible].

Inquiry No 9454 Wanted the name and address of a manufacturer of a machine for [illegible] which will make a [illegible] during the [illegible].

Inquiry No. 9455. [illegible]

[illegible]



and adjustment of ignition systems and carbureters are given special attention, and all accompanying illustrations are of strictly modern engines and their accessories. A trouble chart serves to summarize much of the instruction in an easily accessible way, and this element of time economy is carried through the whole systematic arrangement of the reading matter

THE TESTING OF MACHINE TOOLS By George W. Burley, Wh Ex, A.M I Mech.E. London, England Scott, Greenwood & Son, 1915. 12mo, 240 pp, 110 illustrations. Price, $1.50 net.

This is a book for engineers and students in which testing for accuracy is emphasized as a subject of timely importance There is a good discussion of methods and instruments and the consideration of published results of tests is not slighted Those having charge of classes in machine-tool testing will find the text an able and useful one.

THE BRITISH COAL TRADE. By H Stanley Jevons, M.A., B Sc F S S., F G S New York E P Dutton & Company 1915. 8vo, 876 pp., with maps and illustrations. Price, $2 25 net.

The most important industry of Great Britain is well worthy of study and it would be hard to find a man better equipped for expounding the economic problems it involves than Prof. Jevons. His volume carries a large geological map of the British Isles and deals at length though in popular style, with the industry and the trade particularly in their economic and social aspects His facts are for the most part first hand, many of them will be new to the general public. He gives a clear account of mining methods, the market and by products mining law and the wage act, and the miners life and their housing He discusses foreign trade and the coal question in general There are plans of mines, a graph showing freight variations, and a series of appendices dealing with important points of the subject

A TREATISE ON HAND LETTERING For Engineers, Architects Surveyors and Students of Mechanical Drawing By Wilfred J Lineham New York E P Dutton & Company, 1915 4to, 282 pp illustrated Price, $3.50 net

Unquestionable merit distinguishes Mr Lineham s treatise from the cheap handbooks on lettering that are so often seen Its format is ample and dignified setting off to the utmost advantage both letter press and alphabets, and the quality of paper employed contributes in no small measure to the general appearance of the work A dozen of the most commonly used alphabets are given and great attention is paid to the balancing of words about a vertical centre line Various architectural styles are shown, and there is an architect s drawing half-size which gives all necessary lettering Other inserts deal with surveyor s and machine designer s drawings The instruction is sensible full and clear and the work is irreproachable in taste and in its conformity to the best canons of the art of lettering

SHIP FORM, RESISTANCE AND SCREW PROPULSION By G S Baker Inst N A New York D Van Nostrand Company, 1915 8vo., 247 pp., illustrated Price $4 50 net

Naval architects will appreciate the difficulties involved in dealing with so complicated, and in some aspects contradictory a subject as ship form resistance and power results As superintendent of the William Froude National Experiment Tank the author has had the benefit of first hand investigation leading to important results He utilizes his powers and his experience to the full and despite the difficulty of his subject succeeds in intelligibly conveying accurate and valuable information His book, largely based upon the work of experiment tanks seeks rather to guide the designer as to what should be tested in this way—not to help him to dispense with such tests The subject matter naturally lends itself to treatment under two heads the first division being given over to form and resistance with discussions of stream line, skin friction waves and wave making while the second division deals with the screw propeller in theory and practice Naval architects, engineers and draftsmen will find their needs especially catered to and the book will also prove its value to the student equipped with some elementary knowledge of the subject

THE LETTER-WRITER'S HANDBOOK. By John Rexburn Chicago Browne & Howell Company, 1914. 12mo, 230 pp. Price, 50 cents net.

WHAT AN ADVERTISER SHOULD KNOW By Henry C. Taylor Chicago Browne & Howell Company, 1914. 12mo, 95 pp. Price, 50 cents net.

WHAT A SALESMAN SHOULD KNOW By Henry C. Taylor Chicago Browne & Howell Company, 1913. 12mo, 96 pp. Price, 50 cents net.

"The Letter-Writer's Handbook" is a concise manual for the guidance of all letter writers, and covers both personal and business correspondence. The few specimen forms given are well selected, and all points are thoroughly discussed with a view to making of the reader a finished and efficient correspondent. Mr. Taylor's little works are well known; his experience has been wide, and he has a knack of conveying salient truths in a readable manner. "What a Salesman Should

Know" is of course addressed particularly to the aspirant, although the older hand may find his time well employed in scanning the treatise. The hints on economical travel are money savers, and the suggestions as to approaching the buyer may serve to lay the groundwork of success. In "What An Advertiser Should Know" the small and the large advertiser alike will find a wealth of basic instruction and sound advice. They will find themselves guided toward a wise selection of mediums and a wide choice of advertising plans.

PRINGLE'S IDEAL SHORTHAND. By Harry Polk Pringle. Chicago: Pringle Publishing Company, 1915. 8vo., 180 pp. Price, $2.

The "Ideal" shorthand is a light line, non position system developed by the author in the course of many years of experience. Indirectly based upon Malone's script method, it should present few difficulties to users of the Gregg and other systems which hark back to Malone for their fundamentals. The "invitation of accent" is made a concomitant of the work, and "reinforced vowel forms"—that is vowels followed in the same syllable by L or R—are responsible for much of the simplicity and wide adaptability of the new system.

NAVAL HANDBOOK FOR NATIONAL DEFENSE AND FOR THE EUROPEAN WAR. By Commander T. D. Parker, U. S. N. 80 pages, half tones and line cuts. Price, $1. net.

Commander Parker in this excellent little handbook answers the hundred and one questions which arise in the mind of the average layman, as he tries to follow intelligently the progress of the great war—the man who would like to know how far a big gun can shoot—what is a battle-cruiser—whether an aeroplane can sink a battleship—what are the means by which the British stopped the submarine war against merchant shipping. These and similar questions can be answered if the layman has time to ferret out the information from technical magazines or encyclopedias. But life is too short, he wants the answer at once, and Commander Parker has gathered together with in the 80 pages of his handbook just the kind of information which so many people are seeking to-day. The chapters cover the following subjects: types of warships, the dreadnought, the cruiser, the submarine, guns and ammunition, torpedoes and mines, some points in international law, ships of the air, strength of our own and foreign navies.

EXAMPLES IN ALTERNATING CURRENTS. Vol. I. By F. E. Austin. Published by the Author, 1915. 223 pp. Price, $2.40, in flexible leather.

Professor Austin is the head of the Department of Electrical Engineering in Dartmouth College, and several of his books have already been noticed in this column. This work takes up the solution of problems within its range and guides the student in their solution. The calculus is freely introduced since the grade of the book is that of a college text book. Both discussion and illustration are employed to illuminate the problem at hand. It seems to be sufficient for the field it attempts to cover.

A TREATISE ON THE PIANO AND PLAYER PIANO. By Harrison Louis Van Atta. Published by the Author at Dayton, Ohio. 8vo., 150 pp., illustrated. Price, $1.50.

A piano is a collection of material from all parts of the world. America may furnish iron for the strings, etc., and the various woods used, but the wool for hammers and felts is likely to come from Australia or Africa, while Asia and Africa must supply the ivory and ebony of the keyboard. This treatise not only furnishes piano lovers and owners with an intimate knowledge of their instrument's construction, it also imparts information on the proper care and repair of the piano, including the tuning.

THE THINKING UNIVERSE. Reason as Applied to the Manifestations of the Infinite. By Edmund E. Sheppard. Los Angeles, Cal.: The Authors' Company, 1915. 12mo., 347 pp. Price, $2.

"Finding the Infinite," like "finding God," means divers things to divers people. It is unfortunate that Mr. Sheppard makes the former claim in his dedication. The reader who allows this to deter him from reading the work will miss many a feast of reason. The author's message is something far better and more practical. He shows that right thinking—that is, sound reasoning—must not only characterize the philosophy of the happy man, but is absolutely essential both to material and spiritual progress. The work opens for us fresh vistas, imparts new vigor to the understanding, and teaches us to use the fine comprehension of our better and more rational moments to guide us through the difficulties of our darker hours.

SKUNK CULTURE FOR PROFIT. By F. M. Holbrook. Chicago: Skunk Development Bureau. 8vo.; 120 pp., illustrated. Price, flexible binding, $1; cloth, $1.25.

The author's long personal experience and his original investigations combine to make this a handbook of exceptional merit and helpfulness. The breeding, handling and raising of our profitable little friend, the "[illegible] [illegible]," [illegible] [illegible] Mr. Holbrook [illegible] [illegible] [illegible] [illegible] of land, love and labor; [illegible] need not be extensive, and the man who loves animals and does not begrudge them a little attention [illegible] [illegible] [illegible] [illegible]. Aside from the steady business of killing for fur, he may sell foundation stock and new blood to the fur-farmer; there are many pet stock fanciers, too, all of whom may be prospective customers; to say nothing of the zoological gardens. The author has a happy way of imparting his own knowledge; his pages bubble over with laughable and instructive experiences such as only the veteran fur-farmer could recall. Every phase of the business, from the lay-out and stocking of the farm to disarming, feeding, judging and marketing, is carefully explained in the text, while the lessons are clinched and the enjoyment of the study increased by the wealth of illustration.

ELECTRICITY. By W. H. McCormick. New York: Frederick A. Stokes Company. 8vo., 296 pp., illustrated. Price, $1.50.

A fascinating subject loses none of its appeal by being as well presented as it is in Mr. McCormick's contribution to the "Romance of Reality" series. After a chapter on the birth of the science of electricity, and others on its elementary aspects and such basic devices as the induction coil, the dynamo and the motor, the reader is conducted through an electric power station, and its equipment is entertainingly explained. Subjects further dealt with are electricity in locomotion, electric lighting and heating, the telegraph and telephone in all their modern developments with, of course, ample space devoted to wireless, and the Röntgen rays. Even electro-culture is broached. Our English author here cites an American test upon sheep, in which the electrified animals produced twice as many lambs and a much greater weight of wool than did their unelectrified sisters.

TECNICA DELLA NAVIGAZIONE INTERNA. Canali Navigabili. Ing. Annibale Pai lucchini. Milano: Ulrico Hoepli, 1915. 8vo., 431 pp., con 344 incisioni. L. 10.

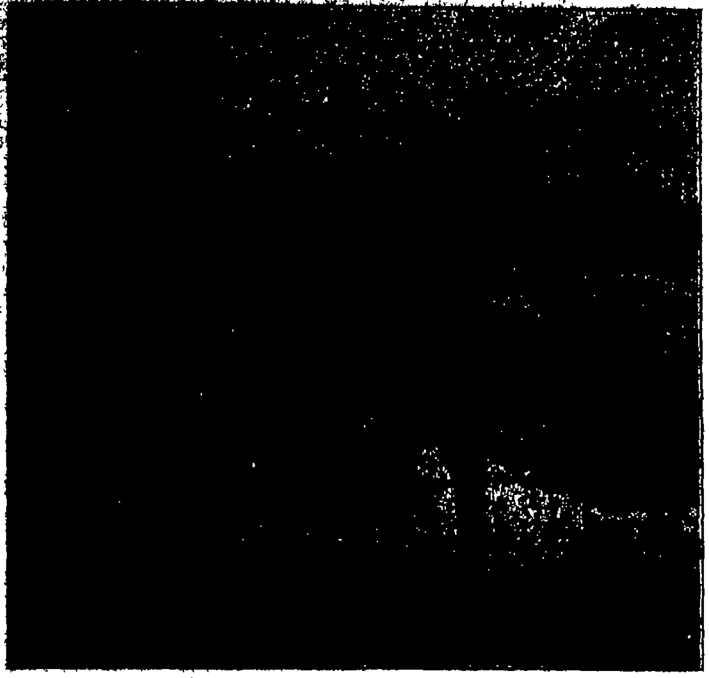
In this monograph, canal construction and operation are very thoroughly set forth. There are descriptions and drawings of the boats commonly used, and some consideration is given to the resistance which the various types encounter as they are drawn through the water. The canal bed, locks, dams, the tow-path, elevators and general maintenance are a few of the heads under which the subject is developed. The treatment is broad, and the illustrations are by no means confined to the works of Italian engineers.

THOMAS' REGISTER OF AMERICAN MANUFACTURERS AND FIRST HANDS IN ALL LINES. New York: Thomas Publishing Company, 1915. 4to., 3,100 pp. Price, $15.

"Monumental" is a much-abused word, yet it seems fittingly used in connection with this mammoth testimonial to American progress in industry. The volume itself is a wonderful achievement of organization, of diligent effort, and of close accuracy. It is, in its final embodiment, a monument to our national vitality and our conquest of the world of invention and manufacture. The work has the distinction of being the largest classified reference book in the world, and it comprises a finding list and index, a list of manufacturers classified according to business, with rating, the manufacturers of the United States, arranged alphabetically by names, giving home offices, branches, officers, sales managers, and purchasing agents, leading trade names and brands, and an appendix dealing with architects, machinists and founders, banks, boards of trade and other commercial bodies, and leading trade papers. In short, those combined directories put into the hands of buyer and seller the addresses of practically all the "first hands" in all lines, together with just such concise information as to organization and standing as the purchaser or the seller must know before he can carry on his business in the most efficient and economical manner. The copies furnished American consulates in foreign cities are greatly in demand and, in view of the war and the consequent closure of many European sources of supply, this service must result in the stimulation of American trade with foreign countries.

A HISTORY OF ECONOMIC DOCTRINES. From the Time of the Physiocrats to the Present Day. By Charles Gide and Charles Rist. Authorized Translation, Under the Direction of the Late Professor William Smart, by R. Richards, B.A. New York: D. C. Heath & Co. 8vo., 695 pp. Price, $3.

Prof. Gide's "Principles of Political Economy" has been widely read in several languages. In "A History of Economic Doctrines" he has collaborated with Charles Rist in an attempt to place modern theories in their true perspective by relating them to their historical forerunners. While much space has naturally been devoted to French thought, the authors have not failed to convey an adequate understanding of English theory, and have done almost equally well by Germany. When we consider the difficulty of [illegible] such a history as this [illegible] [illegible] [illegible], our admiration is aroused at the [illegible] of success which has been achieved. The work is addressed particularly to the student, [illegible] [illegible] brings home to him [illegible] [illegible] [illegible] [illegible] tion of the Marxian doctrine, [illegible]



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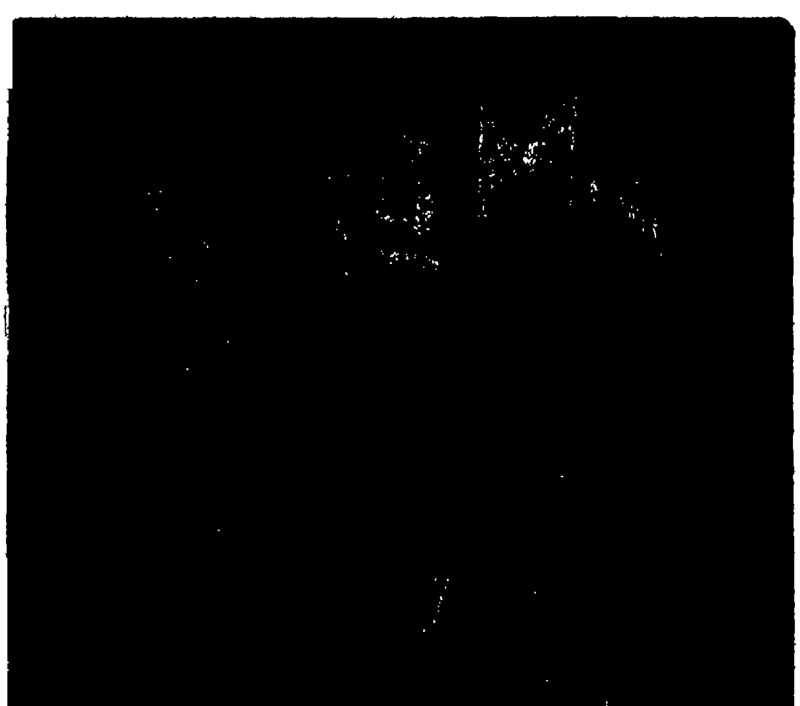

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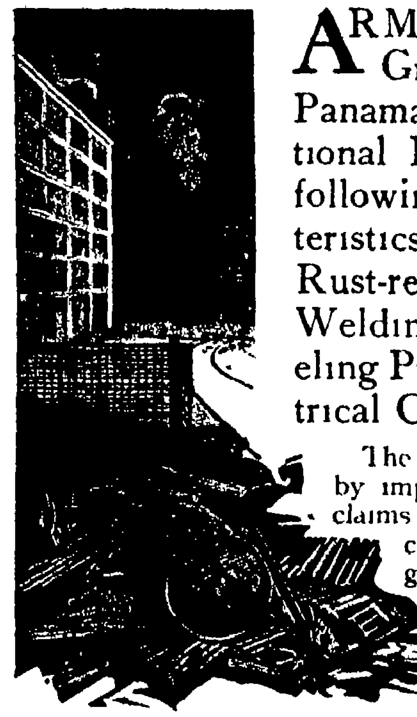

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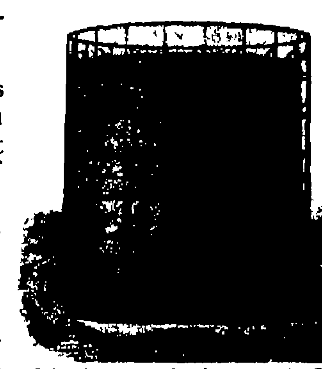
Armco Iron is the most nearly perfect in respect to evenness, freedom from gases and all other features that form the basis of rust-resistance

Paying tribute to needless rust is an economic crime You can now get almost any sheet metal product known made of rust-resisting Armco Iron Among these products are window frames and sashes, ventilators, skylights, cornices, metal lath, smoke stacks, heating pipes, enameling material, water tanks, gas tanks, iron boiler tubes, etc , etc



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PAIGE

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Right now, we might tell you that this new Paige is a startling achievement

We might tell you about its remarkable motor—its luxurious appointments—its rich French leather upholstery—its roomy seating arrangements for five full grown passengers—its ample wheelbase and impressive European stream lines

We might tell you about all of these features—and a great many more But we much prefer that you shall establish them for yourself

We want you to FIND in this car your ideal of what a five-passenger automobile really should be

We want you to personally "discover" the car that you and your family have been waiting for and hoping for these many years

We want you to set your expectations just as high as you possibly can Then, examine this new Paige and see if you are obliged to make one single compromise

We ask you to do this for YOURSELF. We shall be quite content to abide by the result

And, now, just a few words in explanation of the success which has come to this company in such generous measure

First and foremost, let it be understood that Paige builds not for price—but for QUALITY.

As we have repeatedly stated in our public announcements

"It is by no means difficult to manufacture a car for a PRICE, but it is quite a different matter to produce a car of 100-point excellence and still maintain a price to the consumer that is not prohibitive."

There, you have the very essence of the Paige idea

There you have the compelling motive behind every car which has ever left this factory

There you have the REASON for the astounding value which you will find in the new five-passenger model quite as well as the larger Fairfield "Six-46"

REMEMBER, YOU CAN ONLY GET OUT OF A PRODUCT PRECISELY WHAT THE MANUFACTURER PUTS INTO IT

There is no substitute for basic quality No matter whether it be a typewriter, farm tractor or automobile, service must be BUILT IN the product—not merely veneered on the surface

Let us here, then, renew our bond of Faith with the American public

So long as Paige cars are built, we shall unceasingly maintain our policy of building only GOOD cars—with quality our first and foremost consideration

It is a matter of public knowledge that the cost of raw material and labor has vastly increased during the past twelve months

Notwithstanding this fact, however, we pledge ourselves to jealously guard even the quality of every cotter pin which goes into the construction of a Paige car

We pledge ourselves to employ only the BEST materials and only the BEST workmanship that the market affords

So long as Paige cars are sold, we shall remain keenly sensible of our obligation to see that these cars render unfailing service and continue to merit the confidence which has been reposed in them.

On this basis, we ask you to buy a Paige—not because of its price—but because of its nameplate.

We ask you to believe in these cars as WE believe in them. We willingly accept our share of the responsibility.

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Detroit Michigan

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SCIENTIFIC AMERICAN

THE WAR ON PRIVATE CITIZENS

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Paper Pulp Problem

THE problem confronting papermakers of discovering sources of new papermaking material becomes every day more pressing. The prime material in use to-day is wood. Attention was directed to the possibilities of wood as a source of papermaking material by Schäfer of Ratisbon, in 1765, just 150 years ago, but it was not until the middle of the nineteenth century that the commercial use of the pulp of wood was seriously considered. As Schwalbe has noted in one of his illuminating contributions to the literature of cellulose, Schäfer's experiments brought no results except the contempt and jeers of his contemporaries.

The problem in Schäfer's time was to discover a substitute for rags, old linen and cotton waste, which were getting scarce even then, and it is mentioned here to show the similarity in questions which are of periodical recurrence, as well as to give point to a modern issue, for as late as the year 1854 the London *Times* was offering a reward of 1,000 pounds "to any person who shall first succeed in inventing or discovering the means of using a cheap substitute for the cotton and linen materials now used by papermakers, subject to the following conditions:

"1. The material must be practically unlimited in quantity, and be capable of being converted into pulp of a quality equal to that which is at present used in manufacturing the best description of newspaper, and at a cost, *ceteris paribus*, not less than ten per cent lower.

"2. It must be tested, approved and adopted by three eminent manufacturers of paper (two of them to be named by the advertiser), whose certificate shall entitle the inventor to the payment of the reward.

"3. This offer will be in force for a period of twelve months from the 20th of May, 1854."

Papermakers are dependent on the wood of certain pine, spruce and fir trees for the fibers which compose nearly every variety of paper except what are known in the trade as "fine papers," that is, bonds, ledgers and writing papers, and it is only the finer and more expensive grades of writing paper that are free from chemically prepared pulp of wood. The rate of consumption of wood pulp has, indeed, increased so tremendously of late years as to threaten the raw material with extinction, a fate which has already overcome the spruce pulp wood forests of the United States, the great bulk of our wood and mechanical pulp being now obtained from the vast tracts of forest lands still accessible in Canada and in Scandinavia.

The SCIENTIFIC AMERICAN, keenly cognizant of the pressing importance of the problem confronting the American paper industry, never neglects an opportunity of directing attention to possible new sources of paper making material, processes for the re-use of used material, or inventions for the utilization of waste and by-products. In this way note was made in a recent issue of the possibilities of producing pulp from cotton stalks based on the report of an interested student of the subject. The article created considerable interest and led to numerous inquiries from individuals and firms interested in papermaking.

The history of modern invention in papermaking processes since the classical experiments of Schäfer teaches caution in the attitude one must observe toward the claims put forward in behalf of any new invention. While time has amply justified the ideas of Schäfer with regard to the manufacture of paper from a large list of vegetable materials, including wasp nests, peat, straw and the twigs of hops, the utilization of such materials on a commercial scale must wait until the scarcity of forest trees becomes more pressing. The fallacy of proposing various weeds, grasses, waste cotton and corn stalks and many other vegetable matters to furnish fiber has been exposed over and over again by practical men who are aware of the enormous masses of material required and the expense of reducing and bleaching them, to say nothing of the weakness and inadequacy of the resulting fiber as compared with that obtained from wood. The conclusion reached in an article published in the issue of the SCIENTIFIC AMERICAN for January 3, 1914, is still pertinent. Until the price of wood pulp rises to a higher figure than at present, these processes must wait for commercial development, serving meanwhile little more than reserve processes.

A Notable Map of Europe

IN the July number of the *Geographical Journal* Mr. Arthur Hinks, who recently succeeded Dr. Scott Keltie as secretary of the Royal Geographical Society, describes a remarkable cartographic undertaking upon which that famous society is now engaged.

It will be remembered that the preparation of an international map of the globe on a uniform plan and on a scale of 1:1,000,000, after having been talked of for years as an urgent desideratum, was actually undertaken by the principal nations of the world following an international conference on the subject held in London in November, 1909. This work had, however, made but little progress up to the year 1913, when a second conference was held in Paris to settle numerous details that had been left undecided at the first one. The proceedings of the Paris conference have not yet been published.

When the great European war broke out, the need of a uniform and detailed map embracing the various theaters of war and their surroundings was urgently felt by the British military authorities, and only half a dozen European sheets of the International Map had appeared. As each sheet extends over six degrees in longitude and four in latitude, this means that but a small fragment of Europe had been covered.

Almost as soon as the war began the talents and resources of the Royal Geographical Society were dedicated to the task of producing a skeleton map of western Europe adequate for various military purposes, and this has already proved very useful to the British army, especially to the Royal Flying Corps. This enterprise, however, soon developed into the much more ambitious one of mapping the whole of Europe and the Near East on a scale of 1:1,000,000. In other words, the society undertook to produce, single handed and with great rapidity, an approximate equivalent of what the International Map of these regions would have been if it had been completed. The work has made very substantial progress. The society compiles the material and prepares the first draughts of the various sheets, which are then redrawn and published by the Ordnance Survey and the War Office. It was expected that from fifteen to twenty sheets would have been published by the first of August. Several have already appeared.

Even in time of peace, with material and personal aid from the geographers of all the now belligerent countries at the disposal of the cartographers, such an undertaking would have bristled with difficulties.

As might be expected, the spelling of names has been one of the most serious problems, or rather it involves a host of problems. It seems a comparatively simple plan in the case of countries using the Roman alphabet to adopt in every case the official spelling used in the country itself, until one finds that even official spellings vary! Thus at least three spellings of "Bucharest" (none of which agrees with this English spelling) are found in Roumanian government publications.

The greatest difficulties, however, arise from the existence of non-Roman alphabets, such as Russian, Greek, Turkish, etc. Just one example of these difficulties may be mentioned here. In Russian Poland all places have, of course, official names which the Russian authorities write in the Cyrillic character, and this character can be turned into Roman according to a uniform system of transliteration. It appears, however, that such names have been transliterated by the Russians from the Polish (which uses the Roman alphabet with various diacritical marks) according to an arbitrary and faulty system, so that retransliteration into the Roman alphabet produces, in many cases, something quite different from the original Polish name!

The Revival of Blood Letting

ONE recalls how Gil Blas, being at one time in his interesting career very hard put to it for a livelihood, had the good fortune to become assistant to the great Dr. Sangrado, and found himself, without more ado and as easily as any modern quack, a physician qualified to treat any and every human ill; for his chief's armamentarium consisted of the lancet and hot water, with the use of which Gil quickly became familiar. Hot water continues to-day a therapeutic essential. But phlebotomy has long since fallen into innocuous desuetude, mainly because the practice was absolutely without discrimination, every sufferer from no matter what illness was bled, and often to a degree which seems ghastly to the reader of medical history. And not only were the sick, but also the well, regularly bled once or more the year, so that the lancet marks on the body were more in evidence than are vaccination scars to-day. A reaction from such practice, by which the death of our first President was certainly hastened, was of course inevitable.

Venesection or blood letting, is, in discriminated instances, a salutary measure; there are times when it is absolutely essential to life. It must, however, not be done haphazard, in the manner which brought it into disrepute—but scientifically, that is, with knowledge of the disease conditions for which it is appropriate.

Upon what principles? Treat not the disease, to let the patient die, but treat the patient and let the disease die. Judge of the propriety, the amount and the necessity of the repetition of blood letting, by the symptoms exhibited in each case, and not by the nomenclature; observe also the natural constitution of the patient, withholding the lancet in the extremes of life, nor bleed when the blood itself is weak, nor in those invalided for a long time; but bleed when the blood is poisoned by the toxins of virulent infections, when there is excessive vascular tension, when the right chambers of the heart are packed by the excessive unloading into them of thick "black blood" from the engorged systematic veins. There surely can be nothing more scientific nor up-to-date than these principles—which are in the main those taught by Galen.

We may not here enter into particulars such as should obtain strictly in the medical domain, save to note some very recent researches made by Drs. Abel, Rowntree and Turner in the Johns Hopkins Medical School. From a pint to 22 ounces has often been safely venesected from human beings, but to remove more than one third the body's blood supply were dangerous indeed. Not so much by reason of the abstraction of considerable blood plasma, the fluid part of the blood, which is easily enough renewed, but the danger lies in the reduction of the number of the red blood corpuscles or cells which circulate in the blood plasma and have for their office the conveying of oxygen, the life-sustaining gas, to the body's uttermost parts. The excessive loss of these cells puts a task likely to prove unsurmountable, on the organs which normally regenerate those corpuscles. Wherefore those Baltimore scientists have worked on the idea of repeatedly removing large quantities of blood, separating the corpuscles from this by the use of the centrifuge, replacing the plasma by Locke's solution and reinjecting this together with the sedimented corpuscles. This method is as yet unjustifiable in human beings. But their experiments on animals have shown the possibility of withdrawing without apparent injury blood plasma several times in excess of the maximum that can be safely drawn by the usual methods of blood letting, provided the corpuscles suspended in a suitable medium (as Locke's solution) be returned to the vascular system after each vivisection.

Certain it is that centrifugated mammalian blood cells can retain their stability and their vitality when kept on ice four to five days, to functionate normally on being reinjected into the body. Thus, observes the *Journal of the American Medical Association*, a supply of human corpuscles might possibly be kept in operating rooms for rapid injection in emergencies that would otherwise prove fatal. And in the preparation of antitoxin serums from the horse this procedure might obtain, instead of bleeding from that friend of man a few quarts every fortnight, much more might be taken in the same or even shorter intervals, if the animal did not have to regenerate his corpuscular elements.

Colors of Man and Animals

AT a recent meeting of the German Anthropological Society, Prof. Ed. Hahn lectured on human races and properties of domestic animals, dwelling especially on such relations as are found to exist between the outward appearance of human races and the races of man's animal companions. The hues mainly occurring in the case of man as well as of domestic animals are black, brown, red, yellow and white, a remarkable feature being that those external characteristics seem to be connected with the whole of bodily constitution. A distinguished anthropologist, Prof. Eugene Fischer, of Freiburg, Badenia, on evidence afforded by the eye of mammals considers the whiteness of domestic animals and white man to be kindred phenomena, nor does he hesitate to suggest many other analogies of a similar kind between man and animals. According to the lecturer, humanity as a whole, inclusive of what are called primitive peoples, has been subjected for some time, to conditions similar to those at work in the case of our domestic animals. The classification mainly based on color may be replaced by a system of darker and lighter strains within a given race. Attention is drawn in this connection to the Simmenthal oxen, which, within memory of man, have become remarkably bright-colored, as well as to the fact that the subsequent darkening of adults points to the merging, in olden times, of brighter and darker varieties of man.

Electricity

The Removal of Tar from Gas by Electricity is the subject of a patent recently granted to an inventor of Detroit. The operation consists essentially of passing the gas through an electrical field of alternating polarity between receiving and discharging electrodes. It is claimed that the particles of tarry substances in the gas then coalesce and are deposited on the receiving electrode.

Prepared Paper for Insulation.—There has been introduced in Germany a new form of insulating material which is known as "Pertinax." It is made by rolling layers of paper on one another, the mass being then impregnated in some kind of resin while heat and pressure are applied. The different layers adhere to such an extent that the resultant "hard paper" appears uniform in structure. The new insulating material is water proof. It is almost as free from chemical action as porcelain. It will stand temperatures of 180 or 200 deg. Centigrade without harm. "Pertinax" is most readily prepared in flat sheets or cylinders, and it lends itself admirably to machining. Tests indicate that it can be used indoors in replacing porcelain for pressures above 20,000 volts.

Arrangement of Street Lamps.—A recent investigation of the relative merits of parallel and staggered arrangement of street lamps is most interesting, since it discloses that from an ornamental viewpoint, the former is preferable, while, from a utilitarian view point, the latter is preferable under certain conditions. By parallel arrangement is meant the placing of lamps so that they come opposite each other, while staggered arrangement means that the lamps on one side of a street are placed so as to come half way between those on the opposite side. In general, the staggered arrangement furnishes more uniform illumination. However, where the street width is not much greater than the distance between lamp standards, the parallel arrangement is preferable. In instances where the street width is considerably greater than the spacing of the lamps the staggered arrangement will give the best results.

Doors Controlled by Electric Push Buttons.—A Chicago concern has evolved a motor equipment for the opening and closing of hinged doors by the depressing of push buttons. The apparatus consists of a small motor, which drives a grooved drum through a worm gear, a continuous rope which applies the motor's power to the doors, a contactor panel, push buttons, and the necessary accessories. The motor and contactor equipment is fastened to the ceiling near the doors which it operates. A three button control panel is placed at any convenient point. One button opens the door, another closes it and the remaining one stops it. A limit switch shuts off the current when the doors are either completely closed or opened to their full width. It is believed that the equipment will eventually replace the men who are now employed to open and close doors in packing houses and warehouses.

Electrically-Operated Stop Watch.—There has recently been introduced an electrically operated stop watch which lends itself to a variety of applications in the fields of industry and sport. The watch is of the conventional split second type, but the second hand is started by the closing of an electromagnet circuit instead of by the depressing of a button. The watch may be used in conjunction with a speed counter, in which case the circuit is closed and the second hand started at the instant the speed indicator begins to rotate. Removing the speed indicator from a shaft or pulley opens the electromagnet circuit and stops the second hand. Another interesting application of the new watch is in connection with foot races, in which instance several watches are mounted on a panel and each connected to a device at the end of the respective lane. The watches are all started at the crack of the starter's pistol, but stop individually the moment each runner crosses the tape.

Arc Lamps of New Design.—Speaking at a joint meeting of the New York Section of the American Electrochemical Society and the Illuminating Engineering Society, W. A. Darrah described a new type of arc lamp which he has evolved. The lamp consists essentially of an arc chamber in the center of which the arc is drawn between two tungsten electrodes measuring 3-16 inch in diameter. In order to maintain the arc squarely between the electrodes, the latter are partly surrounded by a refractory insulator. Tungsten has been selected for the electrode material for the reason that it is inert, even at a white heat, in the presence of the various vapors used in the lamp. Among the vapors that have been used in the lamp are titanium, stannic chloride, antimony tetrachloride and carbon tetrachloride. The arc chamber is exhausted before the vapors are introduced. The efficiency of the new enclosed arc lamp, together with its convenience—no electrodes to renew or trim—holds much promise for extensive research work in this field of artificial illumination.

Science

Sir Arthur Rucker, who died November 1st, was especially well known for the magnetic survey of the British Isles which he carried out in conjunction with Prof. Thorpe. This work occupied more than 14 years. Rücker was formerly principal of the University of London, retiring in 1908. He was president of the British Association in 1901.

The Superiority of American Clays for use in connection with the glass industry has been demonstrated by tests at the Pittsburgh laboratory of the Bureau of Standards. The Bureau announces that American glass manufacturers will hereafter be independent of foreign material for this purpose. The glass refractories (pots in which the glass is melted) prepared of American clays have been found to give better results than those manufactured with the addition of German plastic clays or of German clays alone.

Monthly Weather Charts of the North Atlantic Ocean are to be published in the future by the Weather Bureau in the *Monthly Weather Review*, together with descriptive summaries of the principal weather conditions prevailing over the ocean month by month. The Bureau will thus make available the great mass of information received from its corps of marine observers who are chiefly officers of ships, of all nationalities. The material for a given month will be published one year late, to allow ample time for the receipt of reports.

Teaching Farmers to Make Maple Sugar.—A consular report states that the quality of the maple sugar and sirup which constitute one of the chief industries of the Province of Quebec has been greatly improved by the establishment of three sugar making schools, one in Beauce, another in the county of L'Islet and a third in the county of Labelle. These schools are very popular with the farmers of the province and help to explain the fact that Quebec's production of maple sugar and sirup, as shown by the last census, was $1,680,393.

Weather Reports from Alaska.—Thanks to the extension of the radiotelegraphic service in Alaska the Weather Bureau forecasters have been enabled to enlarge their field of observation and now receive daily reports from eight stations in that territory and the adjacent islands. Important extensions have also recently been made in the network of stations that keep records of meteorological conditions but do not send telegraphic reports, so that an important body of climatic statistics is growing up, to keep pace with the growing demands for information on the part of prospective settlers.

The Sea Route to Siberia.—In continuation of notes previously published in these columns on the development of a trade route to Siberia *via* the Kara Sea and the Arctic Ocean, it may be stated that successful voyages were again carried out during the past season of navigation. Mr. Jonas Lied reached England October 11th with two steamers bringing cargoes of Siberian produce from the districts of the Obi and the Yenisei. He testified to the utility of the Russian wireless stations at the entrances to Kara Sea. When going east ice was encountered west of the straits, but he received news by wireless that the straits themselves were free, and was thus enabled to proceed.

Protective Stripes Used by Savages.—Describing in the *Geographical Journal* his explorations in the Belgian Congo, Dr. Cuthbert Christy records that in traveling from Stanleyville to Avakubi he came upon a group of forest natives remarkable for the curious way in which they mark their bodies for the purpose of concealment. Narrow stripes of black or red are marked on limbs and face, and sometimes the body. This device has the effect of breaking up the outline and making the person less conspicuous in the lights and shadows of the underwood. Even in the sunlight the duikerboks of the forest will run past the motionless hunter without perceiving him and are caught in nets. It is interesting to note that an analogous device has come into use during the present European war for concealing vessels, guns, etc.

Panama Hospitals, Past and Present.—The Museum of Natural History in New York has recently placed on exhibition instructive models showing the remarkable improvement in hospitals on the Isthmus of Panama between the days of the French canal company and the present time. A hospital of the French period is shown in care of Sisters of Mercy. Pools of stagnant water are seen in the grounds, while the legs of beds stand in tins of water to prevent the enterprising ants, the pest of the Isthmus, from climbing up. Both pools and tins were breeding grounds of malarial and yellow fever mosquitoes, a fact quite unsuspected in those days. Lastly, window screens are conspicuous by their absence. The other part of the exhibit is one of the French hospitals modified in accordance with modern ideas, with well kept grounds, dry cellar, screens, good ventilation and trained nurses.

Automobile Notes

American Takes Charge of Russian Trucks.—In an endeavor to bring order out of the chaos of Russian motor truck transportation, particularly where American made trucks are used, the Russian government last month engaged a Baltimore taxicab service expert to take charge of the entire business.

Night Accidents in London.—Since the streets of London have been darkened at night on account of the Zeppelin raids there have been many accidents to pedestrians from being run down by automobiles. In a recent court case of this kind a bus driver suggested that pedestrians, especially women, should wear light colored clothing. He also said that if people carried a newspaper or a white handkerchief when crossing a street at night, automobile drivers could more easily distinguish them in time to stop. The latter idea might be useful in other places besides London.

Italy Adopts Agrimotors.—Following the example set by France in the subsidizing of motor tractors and other agrimotors, the Italian government has decided to take similar steps in order to prevent the abandoning of farms for which human labor is not obtainable. The first attempts at communal motor farming have been made in the province Cagliari, and public demonstrations of the uses to which agrimotors can be put are to be given in all the provinces under the auspices of the department of agriculture. American farm tractors and farming machinery are greatly desired in Italy at the present time.

Protecting Roads in Winter.—The Department of Agriculture calls attention to the fact that water, and not cold, is the cause of injury to roads in winter, even those of the best construction. It is obvious, therefore, that it is a matter of economy, from every point of view, that roads should be as dry as possible when winter comes on. During the fall the road should be carefully gone over, and all ruts and hollows that can hold water solidly filled in to make the camber of the road surface such that it will drain quickly and thoroughly. Standing pools at the side of the road should also be drained, as they tend to soak and soften the foundations of the road, which may result in bad "heaving" when a freeze comes.

Safety at Railway Crossings.—Although many people are beginning to think that the man who meets disaster by racing a railway train to a crossing is worthy of little sympathy, still there are enough genuine accidents to stimulate suggestions for increasing safety at these points. One apparently effective plan recently proposed is to turn the road at a right angle near the tracks and continue it parallel with the tracks for a short distance before crossing the same by another right angle turn. This would compel an automobile to slow down before crossing the tracks, and should insure the safety of the average driver. Unfortunately there are very many places where such an arrangement is impossible.

Easier Riding Promised.—One of the improvements promised for the coming year is an easier riding car—which is an acknowledgment that there was still something to be desired in this direction. Whatever improvements are effected there seems to be no reason to expect that it will be possible to discard the shock absorber, which has heretofore been found indispensable by those who are critical about their comforts, and this raises the question whether the long flat laminated spring is the best means for absorbing road shocks, for even with the best designs there is no question but that an additional device is required to modify the rebound, and as a matter of fact the initial flexure is either too stiff or else too sudden, although not as objectionable as the rebound. There appears to be an opportunity for a radical change in this feature of car building.

Maintenance Cost of Trucks.—Many business men hesitate to adopt power driven trucks, notwithstanding their remarkable efficiency over horse drawn vehicles, because of the excessive repair expense developed in some cases. That this is the result of misuse by the drivers rather than any fault of the mechanism will be appreciated by anyone who observes for a short time the way many trucks are handled in city streets. Overloading is a common abuse, and equally destructive is the driving of a heavily loaded truck at excessive speed over defective pavements, pot holes and car tracks. No materials now known will survive such treatment, and as much judgment is required to operate a motor truck as was considered necessary to drive valuable horses. A means for overcoming such conditions would be the application of some kind of a recording speed indicator in connection with a clock. With a record of this kind, together with a report of trips made and routes taken, the owner of a truck can easily keep a check on the doings of his drivers, and these same records would also enable him to operate his trucks to the best advantage.

Protecting Galveston's Sea-Wall

Repair Methods Which Are Being Used in Repairing Recent Storm's Havoc

THE different methods used by the engineers in charge of replacing the rip-rap which was washed away from in front of Galveston's justly famous sea wall in the storm of August 16 1915 are presented in the accompanying views This rip-rap consisted of rocks, mostly granite varying in size from a few pounds to several tons

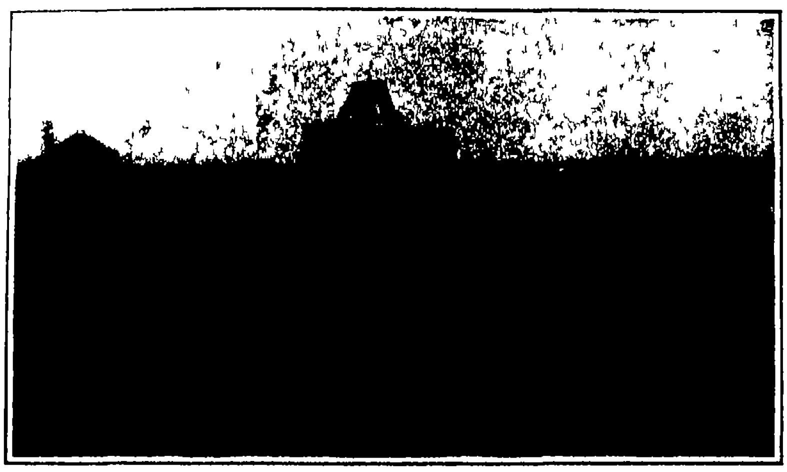
Prior to the storm which destroyed millions of dollars worth of property and cost hundreds of people their lives the rip-rap extended out on the beach a hundred feet or more Its object being to break the force of the waves before they struck the sea wall The force of the storm entirely destroyed the beach which is gradually rebuilding however, and lifted these huge rocks clear of the sea wall and hurled them in some instances across the boulevard just inside the sea wall and 100 feet wide The small stones contained in the rip-rap practically disappeared The destruction of the beach and rip-rap enabled the waves to wash all sand away from the front of the sea wall thereby exposing the sheet piling under it to the action of the teredo a destructive worm which attacks and rapidly destroys wood It is to prevent the action of the teredo and to assist nature in rebuilding the beach as well as to break the force of the waves that the rip-rap is being replaced

The first photograph shows the means used at Galveston by the Engineer Department United States Army, to protect the sea wall in front of the Government reservation at Fort Crockett. The sheet piling at this part of the sea wall was badly exposed, and the repair was an emergency one There was about 2,000 feet of Government sea wall to protect. The rapid action of the teredo called for quick work. The derrick shown was constructed on the spot and moved along the inside of the sea wall by means of a cable and winch The boom had a length sufficient to dump the rock about ten feet in front of the sea wall The method of handling the rock was to have a loaded wagon with a detachable body drive up to the derrick, where a chain was fastened around the wagon body and then, by means of the boom, it was lifted across the sea wall and dumped This method worked very satisfactorily for an emergency arrangement The rock used in the wagon bodies was known as "one-man rock" which means rock weighing from 10 to 25 pounds, or as much as one man can conveniently handle

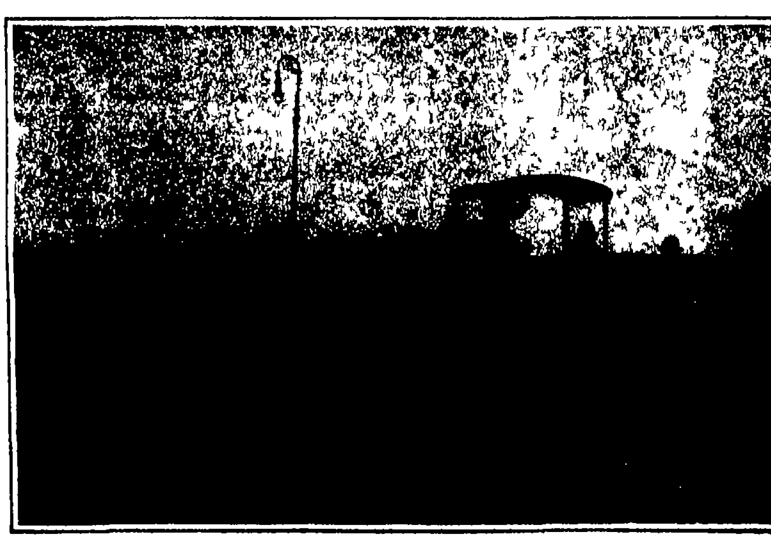
In the second view appears the next step in protecting the sea wall Altogether, there is about 2½ miles of sea wall to protect This part is being done by contractors The small locomotive in the foreground is of the gasoline type and is rated at 60 h p The track has a gage of 24 inches and is laid on top of the sea wall which is 5 feet across, without any ballast other than a few inches of sand in spots The rock used at this time is a little larger than the "one man rock," and is brought to within about 400 yards of the sea wall by rail where it is unloaded into the small dump cars shown and then run up on to the sea wall and dumped over The small engine pulls from 10 to 15 cars at a time each car holding about 1½ tons of rock and a round trip is made every 30 minutes The cars have to be dumped individually but the method of dumping them is so simple they can be dumped as fast as a man can walk from car to car The cost of placing this rock is about $1 75 a ton After enough rock of this size has been placed the little train is used to dump mud shell and sand to fill in the interstices between the rocks. Only two men are required to run engine and dump cars.

The third view shows the final rock used which protects the sea wall from the striking force of the waves—the preceding work protecting the piling from the teredo The rock used by this derrick weighs from 1 to 10 tons and is swung and placed just outside and on top of the previously placed rock While a 10-ton rock seems as though it were a huge rock it is none too large as was demonstrated by the storm, which, among other seemingly impossible things, tore loose from their bases two 18-ton granite blocks that were erected as monuments to commemorate the building of the sea wall and moved them across the boulevard, a distance of 100 feet, without leaving a scratch on the cement walk or brick roadway Examples such as this demonstrate what the waves can do when lashed by a severe storm and cause the people of Galveston County to spare no expense to protect the sea wall which so ably protected them last August

In the first view where the derrick stands and for a distance of about 2,500 feet was solid fill and a wide brick boulevard This was all destroyed in the storm. In the third view the piles seen are all that remains of a famous bath house.



Improvised derrick used by the engineers repairing the Galveston sea-wall, with the contractor's railway at the right



Train of dump cars hauled by gasoline locomotive, used in the repair work on the Galveston sea-wall

Steam derrick employed in handling the final rock, the pieces of which vary in weight from one to ten tons

Zacaton, A New Paper-Making Material

ACCORDING to Bulletin 309 of the Bureau of Plant Industry, U S Department of Agriculture, sacaton is one of the comparatively recent additions to the list of plant materials suitable for use in place of wood and rags in the making of paper stock of various kinds. Zacaton is a plant botanically known as *Epicampes macroura* Benth, a member of the grass family (Gramineae), which among the many natural families of plants contributes so largely to the wants and necessities of man. The Mexicans call this grass "raiz de sacaton," which means root of sacaton, the root being used locally, and also in this country in the manufacture of brushes. The English speaking people in Mexico and Central America refer to it as broom-root grass, wire grass and rice-root grass. The plant yielding this fiber is a common weed, growing very abundantly from Texas southward through Mexico into Central America.

It has been shown that sacaton is worthy of notice because of its capability of being turned to a useful account in the pulp and paper industry From all accounts there is a sufficient amount of this material available within its commercial range of growth to supply a large part of the pulp needed annually in this country The only question confronting the pulp manufacturers is the gathering of the crop and getting the material to the reducing plant without an expensive freight haul

The root of the sacaton plant has a well-established commercial value, and it is estimated that between three and five million pounds are gathered annually A large portion of this amount is shipped to New York at about 13 cents a pound At the present time the tops of the plants dug up for the sake of the roots constitute waste material, and the Department of Agriculture has been directing investigations along this line with a view to discover, if possible, some practical method of using these tops for making paper pulp That the investigations have been successful in this endeavor would appear from the above named Bulletin, in which the results of their tests are given. The conclusions arrived at by the Government officials are in part as follows

The grass can be chemically reduced to paper stock by the soda process under less drastic and less expensive conditions than those employed for the reduction of poplar wood

The well known process, methods, and machinery employed for the manufacture of pulp from poplar wood are entirely suitable for the treatment of this material In place of the wood-sawing, chipping, and screening machinery, a grass cutter, and possibly a duster, is required

A production of 43 per cent of air-dry fiber from the air-dry grass is regarded as a very good yield, the fiber yield from poplar wood being from 46 to 48 per cent, and from esparto 43 per cent.

For bleaching the stock it has been found necessary to use more bleaching powder than in the case of poplar stock.

Paper manufactured from this stock has shown physical tests equal to those of a first-class machine-finish printing paper

Death of Thomas Wallace.

THOMAS WALLACE, founder of one of the first companies to undertake the manufacturing of copper wire in the United States, died at his home in New York city on January 1st.

Mr Wallace was born in Manchester, England At the age of five he came to this country with his parents on the sailing vessel "New York" In 1839 his father established a wire mill at Annsville, N Y, and in 1841 removed to Derby, Conn. In 1848 Thomas Wallace, in company with his brothers and father, founded the firm of Wallace & Company, one of the first to manufacture copper wire in this country He is credited with having been the first to introduce the continuous wire machinery for drawing fine brass and copper wire

Shoulder-Operated Artificial Arms and Hands

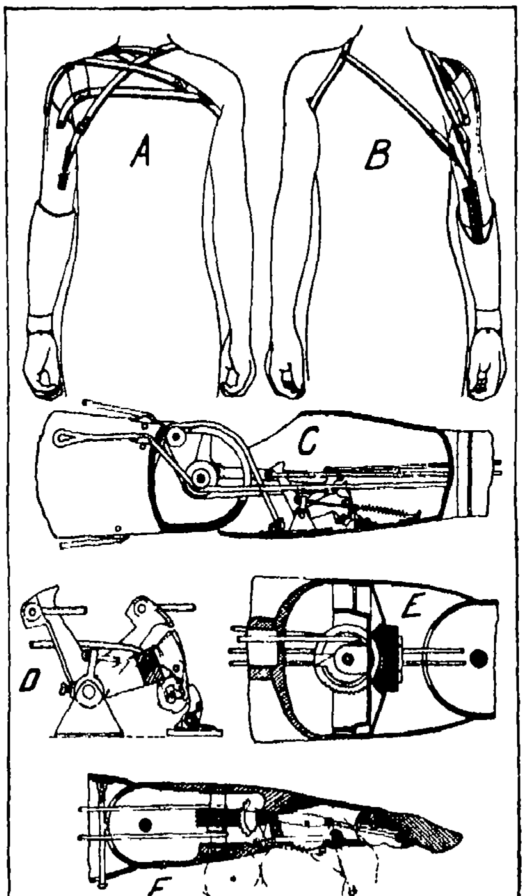
To those unfortunates who have been deprived of their hands and arms through accident or otherwise, it would appear that aid in the form of artificial limbs is about to be realized. At least, the artificial limbs invented by William T. Carnes—an American who, some twelve years ago, lost his arm while operating a milling machine in a Pittsburgh shop and devised the improved artificial limbs during his convalescence—emulate the natural ones to such a striking degree that the handicap heretofore suffered by cripples is materially reduced.

An artificial arm invented by Mr. Carnes was recently exhibited at the International Surgical Congress held in New York, and the dexterity with which its wearer was able to perform different tasks was little short of a revelation. The artificial limb permits of the performance of all ordinary tasks, including the drinking of a glass of water, buttoning of shoes, tipping one's hat and, as an extreme example of its practicality, the carrying of a satchel weighing about 30 pounds.

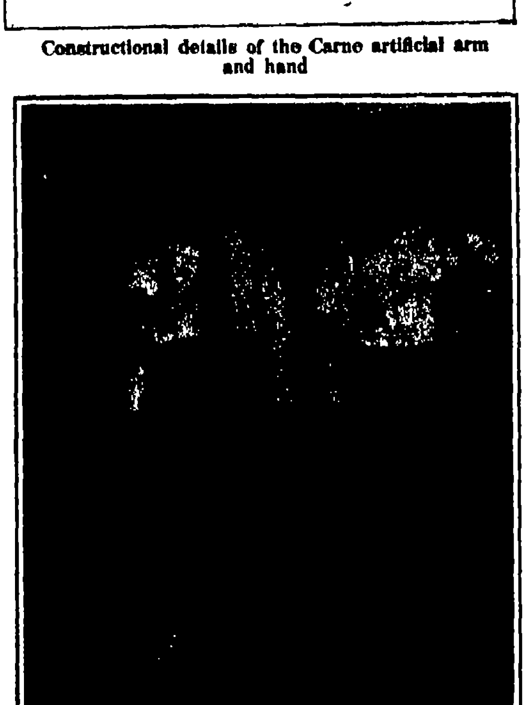
In the Carnes artificial arm, fibre willow is used for the wooden portion, while steel gears take the place of joints and rawhide cords act as muscles. Each rawhide cord ends on a pair of suspenders fastened across the back and the chest, which furnishes the necessary tension. Thus the shrugging of the shoulder is made to control the arm and hand and the 240 parts of which they are composed. The rawhide muscles move the steel joints, and the unison that obtains makes the action of the arm almost natural. The elbow is bent with a simple forward movement of the stump which, by means of the cord attached from the forearm to the shoulder suspender, raises the hand as high as the wearer wishes—high enough to take off his hat or brush his hair, if so desired. A downward movement of the shoulder causes a slight tension on another rawhide cord controlling the fingers, which results in bending the hand backward from the wrist joint and the opening of the fingers. Another shrug of the shoulders closes the fingers and locks them so that they tightly grip the object that is being handled, from a toothpick to a valise. Repeating the downward movement of the shoulder causes the fingers to be unlocked. The wrist is provided with a hinge joint and a button and can be locked securely in three positions. If desired, the button can be pushed back and the wrist flexed automatically by means of the cord which opens and closes the fingers. All the work is done by the shoulders. Raising the elbow moves the wrist one third of a turn.

The accompanying line drawings depict the more important features of the Carnes artificial limbs. At *A* and *B* are shown the back and front views respectively of the shoulder harness or straps and how they are worn. The straps are so arranged that by slightly varying shrugs of the shoulders the rawhide cords actuate the arm and hand in the desired manner. At *C* appears a sectional view of the arm, in which the three cords appearing at the left are, in the order shown, the finger control cord, the wrist cord and the elbow cord. The pivot appearing at the center is the elbow pivot. The two cords at the extreme right are the finger operating cords. An enlarged view of the lever mechanism of the arm appears at *D*. At *E* is shown the bevel gear mechanism which serves to turn the wrist, while at *F* appears the hand member.

Buttoning a shoe with an artificial hand



Constructional details of the Carne artificial arm and hand



Two men who are using the newly devised artificial arms

A Sixty-Cycle Million-Volt Transformer

By Harlan J. Eveleth

Public demonstration of the phenomena associated with high tension electric current attracted considerable attention during the closing week of the Panama Pacific Exposition at San Francisco. Problems confronting the transmission of power at unusually high tension over long distances were investigated. In fact the experiments were performed to ascertain the feasibility of transmitting 500,000 horse-power at a tension of 500 000 volts over a distance of 2000 miles. Contrary to the prevailing impression the installation of the apparatus was not primarily for investigating the effect of an intense electric field upon the dissipation of fog, but numerous experiments were tried along that line when conditions were favorable. At the time of writing the research was incomplete and no specific results had been announced.

The transformer employed in the research was designed by Mr. C. H. Thordarson, of Chicago, and installed at the Exposition at a cost of $30 000. Current is obtained from the mains of the Pacific Gas & Electric Company at a potential of 2,200 volts and is transformed to approximately 1,000,000 volts at the secondary terminals. The maximum rated capacity of the transformer is 1,000 kw. The secondary or high tension coil is wound with 90 miles of aluminum ribbon and is divided into 190 sections or "pies," each section having an external diameter of about 4½ feet, an internal diameter of about 4 feet, and a width of $^{3}/_{8}$ inch. The aluminum ribbon is ⅜ inch in width and about $^{1}/_{64}$ inch in thickness and the layers of each section are separated one from the other by three layers of paper ribbon impregnated with an insulating compound, nearly 1 ½ miles of paper insulation being employed per section. These sections, designed to generate a current of 5 300 volts potential each, are banded both inside and out with copper ribbon, which in addition to facilitating the connections of the terminals of the winding safe-guards the coil from high potential surges. The various sections are separated by a distance of $^{3}/_{16}$ inch and the 190 sections occupy a space of about 6 feet. They are connected in series and one terminal of the assembled secondary coil is grounded.

The primary or low tension coil is wound with copper ribbon and is divided into 122 sections which are connected in multiple series across the 2 200 volt mains. The neutral taps are grounded to the frame of the transformer. Insulation between the primary and secondary elements is maintained by a specially prepared paper tube weighing nearly one ton inserted between the two. Four hundred miles of copper, aluminum and paper ribbon are used in the construction of the primary and secondary coils and the paper tube. The transformer is immersed in 225 barrels of petroleum oil, the whole being contained in a huge, V-shaped structure of concrete set into the earth. The total weight of the transformer alone is about 15 tons. Secondary sections cannot become short-circuited nor is it deleterious if adjacent sections flash over, for the nature of the dielectric medium is instantly self restoring. The constructive features of the transformer are such that sudden internal stresses tend to compress the secondary sections toward the center, parallel to the core, not to disrupt, as usual. These advantages, together with that of lightness of weight are now being incorporated in a similar type of construction in transformers of commercial magnitude.

The building wherein the million volt transformer is housed was erected at a cost of $6 000. It is 75 feet long by 80 feet wide and 2½ stories high, and the open ends through which the high tension leads from the transformer pass out make it appear very much like a Zeppelin hangar. Its construction is unique in that it is held together entirely by iron bolts which run parallel to the high tension wires within, for the danger of fire due to electro-static stress had to be carefully avoided. The switches, circuit breaker, measuring instruments, etc., used for controlling the primary current and determining the power consumption are situated in a corner of the building and are, together with the operator, inclosed in a grounded metallic cage which shields them from inductive effects.

Outside of the building is located an aerial net of wires, measuring 50 feet square, suspended 35 feet above the ground by ropes running from the four corners to telegraph poles. One of the secondary terminals of the transformer is grounded while the other is connected to the net by means of wires which are brought out through the open ends of the building. Beneath the net and on the ground are devices for collecting a portion of the current dissipated from the net and midway between the earth and the net is a screen of rope to protect life in case the highly charged net should fall when persons were standing beneath. At a pressure of 1 000,000 volts, 400 horse-power in energy is required to fully charge the net, and it should be remembered that this current is at a frequency of 60 cycles instead of 60,000 cycles and therefore must be employed with the utmost caution. All high tension leads are suspended by lengths of rope which have been thoroughly impregnated with an insulating material to keep out the dust and moisture. A metallic cage is placed over each juncture of rope and wire to prevent disintegration of the insulating compound due to the brush discharge which would otherwise occur at the juncture, in fact, if the cage were not present the rope would probably be heated sufficiently to cause combustion to take place. The insulation of such high tension current was one of the important problems to be solved.

A large horn gap is used in conjunction with the net to observe a direct discharge from the net to ground. Resistance in the form of a jet of water is inserted in the high tension circuit to prevent a short-circuit of the secondary coil which would otherwise result. The horn gap is constructed of two 10-foot lengths of ¾ inch gas pipe, and the length of the gap can be varied by manipulating a cord which passes through the wall of the building into the metallic cage wherein the operator is standing. One electrode of the gap is permanently grounded and the other may be connected to the net at will. The voltage at the gap, due to the combination of the net and the transformer, is considerably over 1,000 000 volts and a highly luminous arc, from 4 to 5 feet in length, showing heavy frequency bands, is the characteristic type of discharge. The accompanying noise can be heard to a very great distance. The sudden make and break of the arc so affects the electric field between the net and the earth

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Industrial Preparedness for Peace

The Meaning of National Efficiency

By Miner Chipman

Miner Chipman was employed by Harrington Emerson in New York several years before the Efficiency movement had taken hold of the industrial world. As an assistant to Mr. Emerson upon large and important work he received his experience and knowledge of the principles of scientific management. However, Mr. Chipman has specialized on the human element in industry. He attained considerable public prominence when he was engaged by the employees of the United States Government at Watertown Arsenal, Watertown, Mass., to make a study of scientific management in its relation to the laboring man. This study occupied a year of careful investigation. The discontinuance of scientific management in Government shops was contrary to Mr. Chipman's recommendations. He found that the workers were not opposed to efficiency or the principles of scientific management in itself, but were opposed to arbitrary methods of introducing it, and the dictatorial manner of administering the system. The brief prepared by Mr. Chipman is considered to be the most thorough and exhaustive study of scientific management and the human equation thus far prepared.

It is impossible to compress within the few words of a slogan the full meaning of a campaign, and in this introductory article on Industrial Preparedness for Peace, Mr. Chipman endeavors to explain just what kind of preparedness the SCIENTIFIC AMERICAN *is urging. It is not a plea for shop efficiency but something far bigger and broader, namely National Efficiency. This calls for the development of our natural resources, the utilization of our waste products, the cooperation between our manufacturers and our technical schools, the elevation of the entire nation to a higher plane of intelligent effort. While efficiency in the shop plays an important part in our national efficiency, we do not urge a campaign for scientific management that does not take cognizance of the human element.*—EDITOR.

IT is much easier to put under motion a nationwide propaganda for military preparedness than it is to arouse a corresponding public interest in the problems of industrial and commercial preparedness. The reason is a simple one. Military preparedness has a patriotic appeal, it touches the individual's tender spot of nationalism. When men speak of military preparedness they talk about "Our Navy," and "Our Army." Every man, no matter what his business may be, considers himself a preferred stockholder in "Our Navy." On the other hand when we discuss industrial preparedness for peace, we lose the glamour of patriotism, and it becomes a matter of his business, your business and my business. We delegate, through our representatives, the planning and carrying out of an adequate program for military preparedness. Industrial preparedness for peace cannot be delegated. It is your job and my job. The banker, the broker, the manufacturer, the worker, the merchant, the consumer, must all be conscripted into the army for industrial preparedness.

National Efficiency

On December 8th President Wilson in a joint message to the houses of Congress concludes with an appeal for measures to mobilize the industries and resources of the country. He said: "For what we are seeking now, what in my mind is the single thought of this message, is *national efficiency* and security. We serve a great nation. We should serve it in the spirit of its peculiar genius. It is the genius of common men for self government, industry, justice, liberty and peace. We should see to it that it lacks no instrument, no facility or vigor of law, to make it sufficient to play its part with energy, safety and assured success. In this we are not partisans, but heralds and prophets of a new age." What does the President mean by *national efficiency?* What is it to be efficient?

The mechanical engineer's definition of efficiency is the ratio of result obtained to effort expended in obtaining that result. The engineer devised his measurement of efficiency through experiments in the physical world of energy. He developed a conception of units—the B.t.u., the foot pound, the horse power, the volt and the watt. If the nation were made up entirely of physical forces we might apply the engineer's principle of mechanical efficiency. But it is not so. The nation is made up of human beings whose ideals and aspirations cannot be measured in foot pounds or kilowatt hours. A pound of coal contains just so many heat units, a determinable quantity of dynamic energy, but who shall place a limit upon the ideals and aspirations of a people? It is essential, therefore, that we define what we mean by *national efficiency*. A definition of national efficiency that would satisfy Imperial Germany would not, and could not be accepted by the United States. By whatever name we may care to call it, scientific management or imperialistic socialism, it does not matter, our democratic spirit rejects efficiency at the price of individual liberty and initiative.

The worn out business man is invited to the Country Club for luncheon. He is invited to play a game of golf. He has never had a stick in his hand. He plays. He spends 80 per cent of his time in a bunker. He plays exceedingly bad golf. As an efficiency proposition, ratio of result obtained to effort expended in obtaining that result, he has been a dismal failure. He goes home tired and a little sore, but he is filled up with good wholesome air, his joints are loosened up, and for a week or more he has a new grip on life. The efficiency of that afternoon at the Country Club is not measurable in the terms of golf, but in the terms of exercise, good health and new ideals. He takes a new interest in life, joins the club and becomes a crack golfer. He adds ten years to his life. How shall we measure the efficiency of that afternoon in the bunker? Machine efficiency is a static thing. We measure the efficiency of a particular performance; we cannot put ideals into a combination of cogs and cams. The ideal of the builder is there, but it is static, it cannot grow, it cannot change. We do not measure the efficiency of a phonograph by standards of performance found in a sewing machine or in the terms of the family wash. We cannot conceive of the phonograph's suddenly taking on the functions of a sewing machine. With men and with nations it is quite different. The rail splitter becomes the president of his country, the farmer boy becomes the director of the railroad. Agricultural Germany becomes Industrial Germany. Failure condemns a machine, but the failure of men gives birth to new ideals and new aspirations. Organized labor has opposed scientific management, and still opposes it, because it is felt that this difference has not been realized.

The ideals that form the basis of national efficiency are very real things. They are made of the same stuff that forced itself into the great Northwest and turned buffalo pasture lands into fields of golden wheat. It was not the *now* that impelled those pioneers of national efficiency, it was the force of ideals and unbounded faith in the *future*.

The definition of *national efficiency* implies empirical standards of performance. It is the ratio existing between an equitable standard and an actual achievement. The sum total of our national performance divided by the sum total of our national standards represents our *national efficiency*.

National efficiency is measurable only in the units of its structure. If there are groups who prefer sloth to industry, leisure to progress, immediate gain to permanent prosperity, then we must pay the price of inefficiency.

Legislation and National Efficiency

It is almost a platitude to say that laws enacted in behalf of the nation's industries should be of such character as to support the greatest number of industries and provide the means for healthy growth and permanent prosperity. As an ideal this platitudinous principle is all very good, but in a great democracy wherein legislation is enacted by the representatives of clamoring constituencies it is difficult of attainment. Inasmuch as we have pinned our faith in democratic principles and democratic forms, we must look to Congress to enact such laws as will give our industrial and commercial life an adequate opportunity for preparedness to meet any contingency.

We must look forward to constructive legislation. The Government must remove all obstacles in the path of national prosperity. The road to preparedness needs rolling, not plowing. The paths of business need tamping, not tampering. The highway of national efficiency must be wider than a "pork barrel."

There are many who would solve the problem of industrial preparedness for peace by instituting a high protective tariff. There is no panacea for national efficiency. A protective tariff may breed inefficiency. It may protect the weak and allow them to grow fat with prosperity, and so fatten the strong that they will loll in the security of inefficient obesity. There are those who believe free trade will be a cure-all for our industrial troubles. Many believe we can float along and trust in Providence and good luck to save us from disaster. Others view the future with utter indifference. They look upon our future economic and sociological problems as our grandmothers looked upon measles and mumps—necessary evils, the sooner over the better. The problem of industrial preparedness for peace, although largely dependent upon national policy in relation to legislation, does not relieve the individual citizen of his full quota of responsibility.

There is a vast field of activity, research and development open to all interested in our industrial, commercial, and social progress. Entirely aside from political and legislative opinions, the responsibility for *Individual Efficiency* remains the important problem. If we can mobilize the forces of our national society for industrial and commercial security, with the same intensiveness and spirit of patriotism which accompanies preparedness for war, we may look into the future with calmness and faith.

Business Efficiency

In a subsequent number of the SCIENTIFIC AMERICAN we shall discuss the problems of *Business Efficiency* in so far as they concern industrial preparedness and national security. We must be more than efficient producers, we must be efficient consumers. The great mass of humanity making up the nation's labor force must be mobilized for national industrial security. It behooves us to get together and settle our differences in a spirit of democracy. We must be able to appreciate the ideals and aspirations of the whole people, and stamp out the infectious theories of class. We must put away our favorite Utopias for a time, and look the present fully in the face, and await the future struggles fully mobilized. We shall not devise "systems" by means of which all our problems may be solved. We shall endeavor to look into the probable contingencies of the future and outline practical means and methods of survey and examination. If we can get close enough to our problem to pick it to pieces and analyze its factors, the complexity of it all will not discourage us.

Factors of Efficiency. A little while ago the writer was called in to determine the factors of efficiency in a large New York department store. For several weeks the task looked hopeless. The endless amount of detail, the tremendous number of variables, the multitude of functions—all of these things appeared as a confused and meaningless process. Each and every department in the great store had its own problems. A technique peculiar to itself existed behind each counter. The whole world of art and industry was mobilized for the consumer. All the way from an Oriental rug at $20,000 to a paper of pins at five cents, there ranged an infinite variety of merchandise. Back of the salespeople, behind the scenes, we found the great army of helpers—stock girls, clerks, deliverymen, porters and scrubwomen. By analysis and observation we discovered certain clearly defined streams of activity within the store. We began to define functions and examine responsibility. Instead of looking at the store as a whole, we examined its parts with a microscope. We found that the great department store, as an organic whole, was made up of an infinite number of tiny cells, so arranged and functioned as to render service to the whole. In a general way the problem divided itself into four major propositions, viz.:

I. The Consumer
II. The Human Factor (Personnel)
III. Merchandise
IV. Capital and Expense

This vast machine, made up of nicely adjusted parts, was operated for one purpose, and that purpose founded upon one ideal: "Service with satisfaction to the consumer and profit to the merchant."

Scientific Management and Preparedness

By scientific management we mean method, not system. Scientific management means a viewpoint and not a cure-all at $5.00 per bottle. Scientific management is for the man who can have a standpoint without becoming a standpatter. We shall look upon scientific management as that type of management which aims to discover basic causes, procure adequate evidence of fact, appreciate men as well as machines, and, above all else, realize that in America business and democracy are inseparable. The exponents of scientific management must realize that they are not handling inanimate things when they deal with the

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Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Right-hand Rotation

To the Editor of the SCIENTIFIC AMERICAN

There is a very common phenomenon in physics that seems to be badly confused in our text books I refer to the direction of rotation of the plane of polarization when plane polarized light is passed through such a substance as cane sugar Cane sugar, we know, rotates this plane to the right, but the question might well arise in any student's mind, as to what direction this really means. The few following quotations will make my point clear

(1) "Further, some specimens of quartz rotate the plane of polarization to the right (looking in the direction of propagation of the light) and some to the left The former are called right-handed, or dextrogyrate, and the latter left handed or laevogyrate'—Preston, *Theory of Light*, 4th ed p 487

(2) ' Among crystals of quartz there are some that rotate the plane of polarization from left to the right of an observer receiving the light the former are called right handed. —J Walker, *Analytical Theory of Light*, p 344.

(3) . manchen Kristallen nach rechts (für einen den Lichstrahlen entgegenblickenden Beobachter der Bewegung des Uhrzeiger gleichsinnig), bei anderen nach links gerichtet, so dass man Rechts—und Links—Quarz zu unterscheiden hat'—F Pockels *Lehrbuch der Kristalloptik*, p 204

(4) "Die Drehung kann nach rechts oder nach links erfolgen, wobei man diese Richtungen vom Beobachter aus zu rechnen pflegt welchem sich der Strahl nähert. Dementsprechend heisst die Substanz selbst rechtsdrehend oder linksdrehend, '—O D Chwolson, *Lehrbuch der Physik*, Vol 2, p 1002 (Trans from Russian)

(5) ' Pour définer le sens de la rotation, on considère un observateur couché le long du rayon lumineux, les pieds tourné du coté de la source S il voit le plan de polarisation tourner de sa gauche vers sa droite, le corps qui produit cette rotation est dit *droit* ou *dextrogyre*."—G Foussereau, *Polarisation Rotatoire*, p. 4.

(6) "Es giebt Quarzkrystalle, welche die Polarisations-ebene nach rechts drehen (von der Seite des Beobachters im Sinne des Uhrzeigers), und andere, welche die '—Verdet, Wellentheorie des Lichtes, Vol 2, p. 194 (German Trans from the French)

It is not necessary to multiply illustrations The above examples, taken from English, French, German, and Russian texts, ought to suffice to make the point of this communication clear It may be mentioned in passing that the two standard text books in optics for American students, Wood and Drude simply state that in right hand rotation the plane is rotated to the right, which is, to say the least, rather indefinite

Turning briefly to the quotations above, number one is perfectly definite, and incorrect. Number two is definite and correct, as are also numbers three and four In number five we have an elaborate attempt to make the matter clear, but it depends altogether whether the observer is lying on his face or his back, and which way he has his head twisted Number six is correct, but not quite so clearly put as some of the others.

The correct definition of right hand rotation seems to the writer to be the illogical one for when one turns to the right he means that he turns toward his right hand as he progresses. It is otherwise with the definition of the direction of rotation of the plane of polarization. A rotation to the right is defined as a clockwise rotation, when the clock is viewed from the front, that appears to an observer looking not along, but against the direction in which the ray is being propagated.

This may be a matter of small moment, but when one considers that practically no text book in English (with the exception of Walker's, noted above, and excepting an article by the same author in the *Encyclopedia Britannica*) has this matter stated either definitely or correctly, and when one considers further the importance, both practical and scientific, of this phenomenon, there seems, after all, some excuse in calling attention to it. L. P SIEG, Ph.D

Asst. Professor of Physics, University of Iowa.

Giant Kew Pineapple

To the Editor of the SCIENTIFIC AMERICAN·

In a recent issue of your paper I read a letter from Sarawak, regarding the Giant Kew pineapple In 1891 I imported some of these plants from Heneratgoda, Ceylon, and about the same date Mr G C. Matthams, a neighbor, obtained some from India also. They proved to be what we had been propagating for years in Florida under the name of Smooth Cayenne This variety has been gradually discarded for open field culture so that now I don't believe one could find an acre left on the entire East Coast The reason is that while it is large and of superior quality the fruit does not ship or keep so well as the Red Spanish and the plant is more subject to the pineapple disease Some acreage is still being grown on the West Coast, where shedding is required to keep off frost In the latter part of the last century large quantities of these plants were shipped to the Hawaiian Islands where they have formed the nucleus of an extensive canning industry At the time these were sent away, the out of-door growers on the East Coast had already concluded to discard this variety for the Red and were glad to dispose of their plants

JOHN BEACH

West Palm Beach Florida

Increasing Our Means of Defense

To the Editor of the SCIENTIFIC AMERICAN

Many ways have been suggested by experts and lay men for enlarging the Army, and for adding to the strength of the Navy, but no ways have as yet been recorded that are acceptable to all

Our Army is the smallest in proportion to the area and wealth of the country of any army in the world Our little Army, however, is as efficient, man for man as any, and is always in training for any emergency The same may be said of the Navy As to the National Guard, the people of the different states judge the whole guard of the country by what they see of it in their own state, city or town The United States Army officers who are detailed to inspect and instruct the National Guard are doing everything in their power to make these troops as efficient as possible The Naval Militia is small in number, as compared to the National Guard, but is well trained in many of its duties

The volunteers in all branches of the service have always given good account of themselves when called upon by the President, as the history of the country will tell

In recent years it is apparent that many people seem fearful of the consequences of having marines and sailors land in foreign countries to protect the rights of their country The promptness with which the armed forces (or police) are used when necessary is what produces the desired effect, and makes them command the most respect, and at the same time preserve the respect for their country's flag.

There was a time when military parades would pack the streets with spectators from curbs to house lines, but now there is often but a thin line of onlookers along the edges of the sidewalks on these occasions

The troops are not to blame for the scarcity of enthusiasm among the citizens as they are better than ever in point of efficiency, appearance and in numbers

It is the citizen that is lacking in spirit, and this lack of spirit has been gaining year by year for some time There are many able-bodied citizens of eligible military age, who would feel as constrained and uncomfortable in the Government olive-drab as they would in another style of uniform furnished by the Government and states of a material with a horizontal pattern. Many would join some military organization, no doubt, if they could become officers at once without having to climb the ladder to earn their shoulder straps. If one learns early to obey he will be the sooner able to command

It has been a surprise to many to see the numbers who have never had military training volunteer to serve at the Plattsburg Camp of Instruction and similar camps, and spend a month in Army uniforms, in vigorous training and learning the first lesson of a soldier May their example be followed by many others each year Such camps should have been started years ago before the present war cloud settled upon the earth

The men trained at these camps should keep their uniforms and organize into bodies of 'Minute Men" The Minute Man of the American Revolution had his flint lock, powder horn, bullet pouch, and haversack, and was ready at all times when his services were needed by his country In those days, about all that many could offer was their willing assistance, but few were thoroughly trained in the manual of arms tactics and well disciplined The Modern Minute Man should be "trained to the minute"

For many reasons it would not be advisable or necessary for members of such organizations to personally own a military rifle, these should be the property of the Government, and kept in arsenals ready for use, but the service uniform (which should fit the wearer) and equipment, consisting of hat, coat breeches shirt, leggings, shoes, cartridge belt, haversack and canteen could be the property of each man The equipment mentioned, but not including the shoes, will cost $14 50, which is less than most outing suits will cost, and it will be serviceable for several camp tours with proper care

The enlisted men of the National Guard are furnished with field uniforms free of charge

As the numbers of men who have received military training increase the feeling that many people have that when a number of men are gathered together in uniforms fully equipped it is a declaration of war, will gradually wear off and slowly but surely the public in general would consent to an increase in the numbers of our country's defenders

The days of the steel and masonry forts have passed We are back again to the days of earth works Heavy earth works as enduring as the hills should be built to guard the coasts Where fortifications can be placed in good positions behind natural hills over which the guns could shoot, it should be done

The highways and railroads of the country could be utilized for military purposes and where necessary to make the systems complete for military purposes, a continuous line parallel with the coast, and at a convenient and safe distance from it could be built with radial lines running inland to bases of supplies These bases in turn would be similarly connected with large reserve supply depots farther inland By having such a system for convenient travel troops, heavy and light artillery, and the necessary ammunition and supplies could be rapidly sent to any point This, too, would allow a smaller number of troops to defend the country on account of the rapidity with which they could be sent from place to place where most needed

No doubt our military leaders have some such scheme for protecting the country but they should be authorized to carry out their plans

Fort Columbus on Governors Island in New York Harbor was built with the assistance of students of Columbia College in the year 1800 Our reserve troops could assist in building the military roads, railroads and fortifications, nearest their homes, and placing the guns as part of their duties

All men in the reserves would not be required in the field, many would be required in arms and ammunition factories and others employed upon uniforms and equipment Those so employed by the Government in case of war should get credit for their work in serving their country as do those in the field

There is use for practically every trade and profession in military and naval service so there is for unskilled men and the deserving unemployed

Every factory owner should ask How can I best adapt my factory for use in making war supplies?" The War Department should have experts who could answer the question, and furnish plans for making plants suitable for use in case of war The trained mechanics of the reserves could be employed to make the necessary changes required by the plans of the experts

Meeting places for those who wish to take up military training should be found throughout the country and instructors appointed Certificates of proficiency under the several branches of instruction should be issued to the students and they should also receive badges for marksmanship like those issued in the Army and Navy Instructions should be given in every branch of the service, including sanitation, cooking and transportation and in addition, practical work should be conducted in the field during each year of the service

The National Guard organizations are authorized to organize what is known as Depot Battalions as auxiliary troops and it should be possible to make use of the armories for meeting places and for drilling the reserve troops under this rule

The boy scouts who are getting excellent training that helps to make good citizens and soldiers, could join the reserve troops or National Guard when they reach the age of 18, the minimum age for enlistment

A military training goes a great way towards making a better citizen, and every able-bodied citizen should be willing to receive such training for his own and his country's good Incidentally, if military training and discipline were more general there would be less danger from panics at fires and where large numbers of people are assembled The traffic regulations used in city streets are nothing more or less than thorough practical applications of military order and discipline

The prescribed ages of men eligible for military service are from 18 to 45 and all citizens should do their duty towards their country and state at some time of their lives During the time of peace everyone should perfect himself in some way so as to be useful in time of war

Those who have served their state and country in time of peace or war have always a feeling of great and continued satisfaction for having done that service.

GEORGE P PERRINE,
Captain 71st Inf N G, N Y

Ford tractor, equipped with wheels for road work, hauling a farm wagon

Gas tractor hauling a disk harrow through a ploughed field

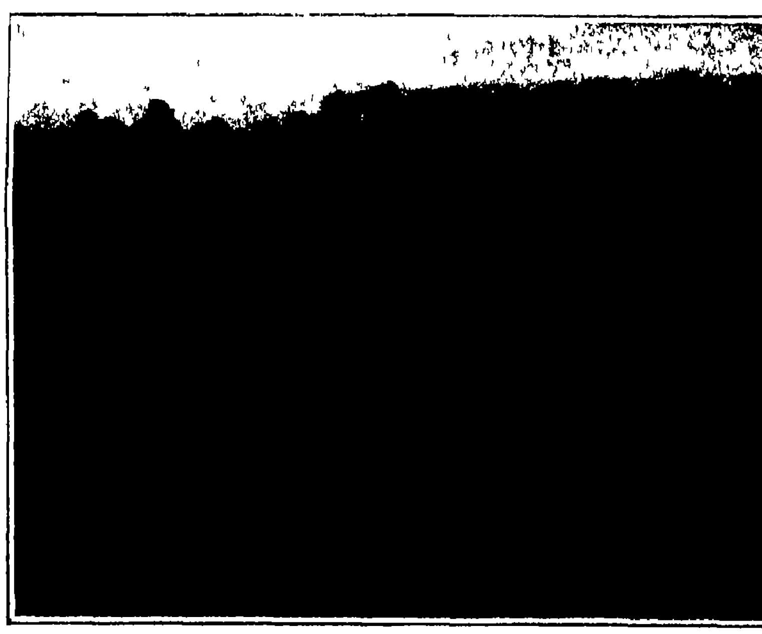
Light-Weight Gas Tractor for the Farm

ALTHOUGH circumstances resulted in his entering the business of manufacturing motor cars it is said that the earliest ambitions of Henry Ford were to build a light weight, inexpensive gasoline tractor for the farmer and ever since driving a steam engine on a Dearborn farm some thirty four years ago he has cherished the idea, despite his successes in automobile manufacturing. At last his idea is coming to be an accomplished fact.

For the past three years the Ford tractor has been under construction and in practical operation it being the intention of the designer to thoroughly develop the machine before placing it in the hands of the farmer. In other words it will only be offered when it has out grown the experimental stages.

The tractor shown in the accompanying illustrations represents the realization of Mr Ford's long cherished idea. It is equipped with the regular 20-horsepower motor used in his motor cars, and has a frame constructed of special vanadium steel, which gives it the advantages of extreme toughness, durability and light weight, the last named feature being of paramount importance. The tractor weighs but 1,500 pounds permitting of its use over the softest ground.

The one striking feature of the Ford tractor is that, instead of being extremely heavy and complicated in construction, it is little more than a clever adaptation of the light weight motor car plant to a small but powerful chassis the wheels of which can be changed according to the nature of the work at hand. With an average fuel consumption of one gallon per hour, the tractor has a working speed of from two to four miles an hour, and can draw a heavy load on the road at twenty miles per hour. A new type producer is used which utilizes the exhaust heat to change the liquid fuel into gas. Any fuel which boils below 550 degrees Fahr can be used, among them being gasoline, California distillate or kerosene. As gas is used for fuel, there is no smoking, and the spark plugs very rarely have to be changed.



Ploughing a field with a heavy plough drawn by one of the new farm tractors

The influence the new tractor will have on the work of the farmer—particularly the small farmer, whose needs are not catered to by the larger gas tractors—is certain to be great. Although the new tractor is said to do the work of four horses, its initial cost and upkeep for a year is less than the initial cost and upkeep of one good horse for an equal period. The advantages the tractor possesses over the horse are many among the more important being the following. The tractor does not consume "food" or fuel when not at work, hence in inclement weather and during the winter months there is no upkeep cost. It does not overheat while at work, even on the hottest days, and, unlike the horse, it does not have to be rested every half hour because of excessive heat, the flies do not bother it. It does not break out of the pasture and get into a cornfield and overeat, nor lie down and die wherever the driver leaves the tractor he is certain to find it standing where he left it and not engaged in eating leaves from the hedge fence, and, finally the tractor does not become frightened and run away. These are but a few of the points in favor of the tractor from the farmer's viewpoint.

The following contrast between the work of horses and the tractor is of interest.

A DAY'S WORK

Two horses	6½ acres 32 quarts of oats hay and bedding 2 hours labor	Always whether at work or idle
Ford tractor	24½ acres. 10 gallons of gasoline 1 gallon oil.	When at work. Idle it costs nothing

The main application of the tractor on the farm is naturally and obviously the hauling of agricultural implements over the fields and the transportation of products to market or shipping point. The experimental tractor has proven successful in ploughing, in hauling a double disk harrow and in cultivating corn, in reaping wheat with a battery of seven Ford tractors, in which instance each tractor pulled a binder with an eight foot knife, in harvesting wheat, and in hauling a 6700-pound drill over a distance of 135 miles, during which journey the trailer broke down. On the other hand the tractor is available for every kind of trucking on good roads and bad roads about the farm and cross country. One of the new tractors and two trailers accomplish the work of two heavy trucks and last longer cost less to maintain and the first cost is less than the cost of one truck.

That the day of emancipation of the farmer is at hand appears a certainty, for much of the hard labor heretofore associated with agricultural pursuits is to be taken care of by the new tractor.

The Automobile Show

THE annual automobile show has always been immensely popular in New York and both those who have and those who have not turn out each year with equal enthusiasm to inspect and criticise the new offerings by the trade. That the automobile should arouse such universal interest not only in New York but everywhere else, is not surprising, for it embodies the spirit of the times in a way not found in any other single structure—the hustle, excitement and the get there spirit so characteristic of to-day, and it is hardly necessary to add that the 1916 show was a complete success. Eighty seven makers were represented and they exhibited over three hundred cars, covering a very wide variety of models and sizes.

From every point of view the present exhibition was by far the finest that has yet been staged. Every well known car was adequately represented, and the artistic excellence in design was practically universal and notable for the high standard attained. It is true that in fundamental features there was a striking similarity throughout the halls, but the excellent taste displayed removed all impressions of monotony, and there was sufficient individuality in detail to meet the requirements of those who desire distinctive features. In mechanical perfection the same progress was everywhere in evidence in the carefully finished designs that mark the work of the scientific engineer. The accessory section of the show gave the same impression of progress for there was a noticeable absence of freaks and the great majority of the multitude of articles shown were of undoubted utility, well and substantially made.

The features of the show were the multi-cylinder engines, the increased comfort indicated in every detail, and the decrease in weight, and to these points should be added the general tendency to a decrease in prices. Of course, the great novelty was the new twelve cylinder engine, which won general approval on account of the careful working out of designs and details, which gives confidence in their satisfactory operation in the hands of the general public. Six of these remarkable engines were to be seen among the exhibits, while of the eight-cylinder machines that made their appearance last year, and which have met with such great favor, there were several new recruits this year, and this model still holds attractions as a novelty. However, the makers who pin their faith to the well tried four and six cylinder engines have not been idle, for many, by carefully revised designs and improved methods of building, have been able to secure increased engine speed, with an accompanying increase in power and flexibility that makes them extremely satisfactory to all but the hypercritical. Excellent examples of such engines were seen among the cars shown, and there is slight possibility that the fours and sixes will lose the position they have held so long and successfully.

Besides the study that has been given to the motors, considerable attention has also been given to the gears and transmissions, and it was very noticeable how greatly the size and also the weight of these essential parts has been decreased, largely by judicious selection of materials.

The same study of materials generally has resulted in material decreases in total weight in the case of a number of cars usually accompanied by increased strength and stiffness, and this is a point worthy of consideration by purchasers, as the less dead weight a car has to carry the longer its life.

There is a general tendency to extend the electrical equipment as a regular part of the outfit, the electrical starter being almost universal, while generator sets for lighting are rapidly becoming more common.

Although not new in principle, the latest development of the electric drive may be classed as among the notable features of an unusual exhibition, and undoubtedly marks an important departure from current accepted practice.

Body design and construction, as seen in this exhibition has reached a high state of excellence, a simple elegance being the characteristic that is very effective. Long, easy flowing lines, with a minimum of sharp corners are predominant, and although the majority of the cars shown were in black, there were numerous examples of quiet tints that are exceedingly attractive. Great ingenuity was shown in the seating arrangements, the divided seat being conspicuous, while various arrangements of offset seats add greatly to the comfort and the capacity in many cases. Convertible bodies were an important development that adds to the usefulness of the automobile.

Among the numerous classes of exhibits shown in the accessory section particular attention was attracted by tires which show results of constant study and experiment in their improved durability and comfortable riding.

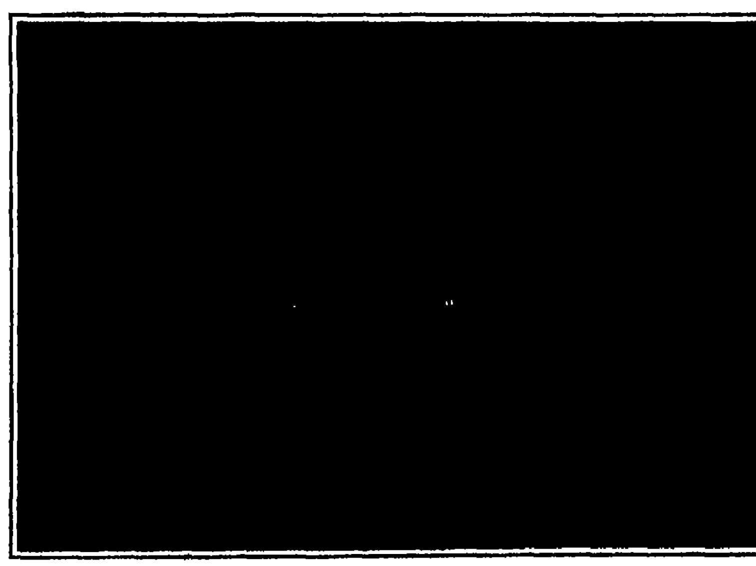
Taken as a whole, the Sixteenth Annual Show can be rated as the most notable in the history of these events and an instructive revelation of the possibilities of scientific engineering and modern methods of production.

Nature's Bomb Dropping from Aircraft

By S. Leonard Bastin

THERE must be very few human inventions that have not been forestalled by Nature. Nowadays when all the world is talking about the wonders of bomb dropping from aircraft it is interesting to consider that the same thing has, for untold ages, been carried out by plants In the case of not a few plants, where the seeds or fruits have a wing like or a parachute attachment, special arrangements are made for the dropping of the burden in certain circumstances. Thus, if the winged seed of a pine knocks against the branch of a tree, or is stranded anywhere, the membranous wing at once becomes detached The heavy seed is no longer supported and it at once falls to earth. In the fruits of many thistles a similar plan is to be observed The fluffy parachutes float about in the air for a considerable time and may travel a considerable distance The moment one of these strikes against an obstacle or is hung up in any position, the fruit at once is severed from its supporting parachute and naturally falls to the earth Without a doubt this dropping of fruits and seeds accounts for the fact that by the side of walls and hedges there are to be found so large a number of plants bearing seeds which are dispersed by wind agency The processes knock up against the obstacle and the seeds drop to the ground beneath

A curious anticipation of bomb dropping from aircraft is seen in the flying fruits of the California pine



The fruits of many thistles drop their seeds when they brush up against a branch

Probable Perception of Invisible Light by Some Animal Species

By J Fidel Tristan and Gustave Michaud

Costa Rica State College

MANY animals can emit sounds either higher or lower in pitch than those utterable by man The same differences have been observed in the organ of hearing, some insects being able to detect sounds of such a wave length as to be inaudible for man. It is perhaps generally and implicitly admitted that no such differences exist in the perception of light of different wave lengths throughout the animal kingdom, and that all eyes, whether small or large, simple or complicated, are keyed exactly to the very same scale of wave lengths which man is able to perceive, yet we fail to find anywhere any proof in favor of such an assumption. On the contrary, the extreme diversity in the anatomy of eyes—in the general plan as well as in the details—added to the fact that some eyes are more complicated and even more perfect than ours, those of birds, frogs and dragon flies for instance just as the nose of dogs is more perfect than that of man make it probable that some species can see beyond one extreme at least of our visible spectrum while being perhaps insensible to the other In other words, while some species may not see the extreme violet they may perceive some of the spectral region which follows the extreme red, *i e*, the infra red Again, other species which may be insensible to the extreme red probably readily perceive some of the ultra violet Some very clever experiments made by Sir John Lubbock seem to give a firm foundation to the latter hypothesis, so far as ants are concerned Says the English naturalist

"This seems to me strong evidence that the ultra violet rays are visible to the ants. Now, as every ray of homogeneous light which we can perceive at all appears to us as a distinct color, it becomes probable that these ultra violet rays must make themselves apparent to the ants as a distinct and separate color (of which we can form no idea)

It is easy to see that such a shifting, upwards or downwards as the case may be, in the scale of perceptible wave lengths would be extremely useful to some species. We have shown recently that photographs made in infra red light reveal with a wonderful clearness the smaller details of far away objects Birds which rely, for the finding of their food exclusively on the vision of very distant objects (vultures and other raptores) could see better if their retina were blind to the diffused and troublesome violet and blue, while sensitive to some of the invisible infra red for which the atmosphere is extremely transparent We have also shown that if any living being were sensitive mainly to solar ultra violet grass foliage and flowers would appear to him as dark or black while a considerable number of yellow flowers would be for him of a bright luminous color—and white as snow on photographs made in ultra violet light

Now corollas are organs the main function of which is *to be seen* in order to attract those insects which play an important part in the fecundation, if no insect can perceive solar ultra violet light how is that some flowers are dyed with an intense ultra violet color?

Such is the problem which led us recently to photograph in ultra violet and infra red lights, a number of butterflies insects the chromatic sense of which is probably highly developed, as, in both breeding and feeding they are guided mainly by their sense of color The three accompanying photographs embody the main results of these researches, which can be briefly stated thus

All pigments on some 65 species of brightly and diversely colored butterflies absorb more or less completely ultra violet light of the 3,150-3,250 A. U wave length The only exception to that rule is a particular kind of yellow pigment which, on the contrary, reflects the short waves so powerfully as to appear snow white on the photographs made in ultra violet light Sometimes the eye does perceive a difference between the yellow pigment which reflects the ultra violet and that which absorbs it In other cases, such a distinction, at simple sight, is impossible In many instances one and the same butterfly carries on his wings both kinds of yellow pigment (*Callydrias philea*, *D*, in the three illustrations) just as some ultra violet flowers may appear to be uniformly yellow until a photograph in ultra violet light revels the presence of yellow zones which power

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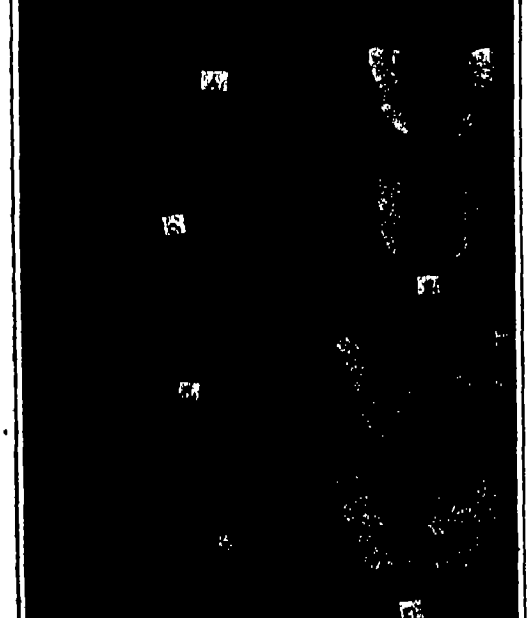
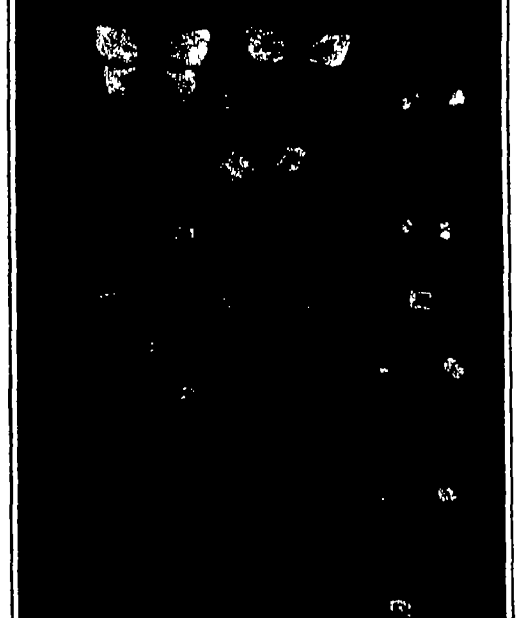
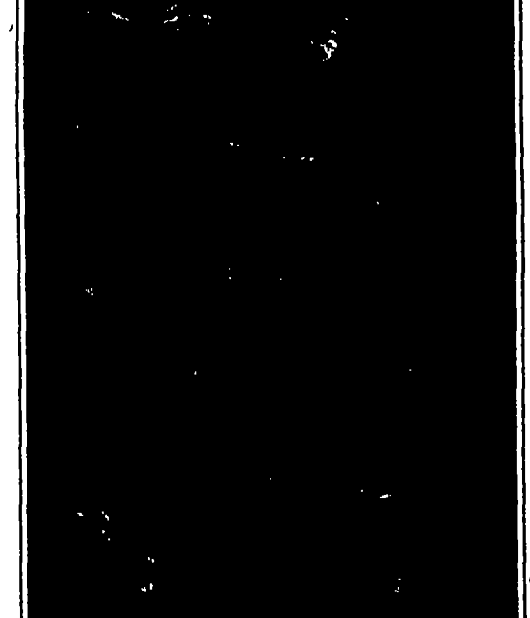


Photograph No. 1. Made on an orthochromatic plate with a weak yellow screen, showing the relative luminosity of colors about as the eye sees it



Photograph No 2. Same subject as No. 1. Photograph made in ultra-violet light with Foucault's silver film, deposited on a quartz lens



Photograph No. 3. Same subject as No. 2. This photograph was made in infra-red light with Wood's filter, or sensitized plates

A 1.—Phoebis Argante; *B* 1.—Rhabdodryas trite, *C* 1—Phoebis rurina, *D* 1—Callydrias philea, *E* 1—Anteos chlorinde *F* 1—Papilio sp

Two types of high-frequency alternators for wireless telephony

In the type appearing at the left the motors at either end drive the inductor disks of the dynamo in the center in opposite directions, so as to give an effective speed twice as high as that of the shafts. At the right appears a modern Fessenden radio frequency alternator which operates at a speed of 2,000 revolutions per minute. It is driven through gears at the center and produces 2,000 watts of alternating current at 100,000 cycles per second

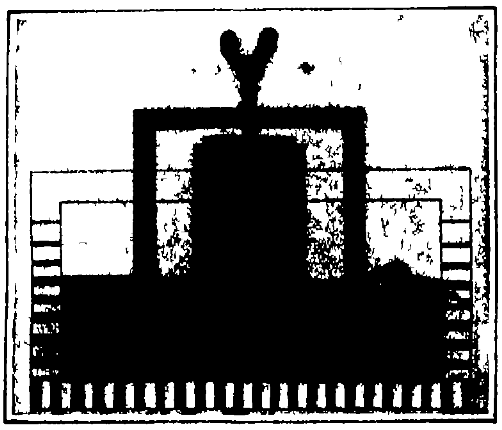
Progress in Radio Telephony

Present Status of the Art the Result of a Decade of Experimenting

By John L. Hogan, Jr

THE conception of radio telephony as a technical possibility dates back almost to the discovery of radio telegraphic receivers which gave indications proportional to the amount of energy arriving from a transmitting station at any instant. When the first of these were put into use and the listening operator found himself able to hear reproduced all the flutters and variations in tone of the spark at the sender, the basis for the wireless transmission of speech was at hand. It remained for the inventor first to develop the idea of sending a practically continuous stream of electromagnetic waves from one station to the other, varying them in size or otherwise according to the voice-vibrations of the speaking operator, and second to devise instruments for such wave production and modulation.

The first wave-stream generators were of the high group frequency spark type, which set up waves in trains at the rate of 10,000 per second or so. Soon there were built radio frequency alternators which produced current of 10,000, 50,000 and even 100,000 cycles of reversal per second, which when connected to properly adjusted networks of aerial wires would cause absolutely continuous streams of waves to be radiated into the "ether." By the use of such generators with special carbon microphone transmitters or relay amplifiers for modulating the wave streams in accordance with the sound waves of articulate speech, R. A. Fessenden found it possible to practice radio telephony as early as 1901. In 1907 the apparatus was so far developed that speech was transmitted from Brant Rock, Mass., over 200 miles to Jamaica, N. Y., and occasionally from Brant Rock some 400 miles to Washington, D. C.



Small quenched spark gap used to generate waves in polyphase radio telephony. The key serves as a comparison for size

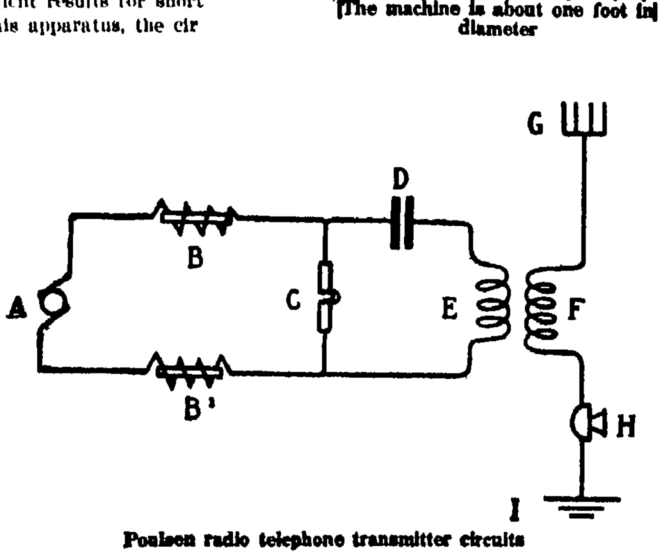
Quarter kilowatt 2,400 cycle 150 volt polyphase alternator for producing high frequency sparks. The machine is about one foot in diameter

Among the early workers in wireless telephony after Fessenden, was Valdemar Poulsen of Denmark, who improved upon the Thompson-Duddell arc for production of high frequency alternating current by causing the electrical discharge to pass in an atmosphere containing hydrogen gas. It is not yet certain that this method of increasing the frequency and stability of the "singing arc" discharge is due to Poulsen alone, but it is none the less a fact that he has used the arrangement for a number of years with excellent results for short and moderate distances. With this apparatus, the circuits of which are shown herewith, continuous current is converted directly into rapidly alternating currents similar to those produced by the high frequency alternator discussed above and suitable for setting up continuous streams of electromagnetic waves when led into an aerial wire circuit. For securing control of their strength by speech, a group of the usual carbon transmitters is connected into the circuit. Thus the system is limited by the restricted power which the microphones can modulate as well as by the characteristics of the arc itself. Similar arc and microphone radio transmitters have been built by a number of other investigators with only minor changes in detail, but these have failed to give entire satisfaction over distances even as short as 10 miles, though Poulsen is believed to have talked over 100 miles.

In the early days of radio telephony, say up to 1908 or 1909, some interesting work was also done by Count von Arco of the German "Telefunken" Company. His wave producer consisted of a number of water-cooled arcs in open air (the hydrogen atmosphere being omitted) connected in series, and a carbon microphone designed for large current values. With this instrument speech was transmitted from the Navy station in Brooklyn to that at Fire Island, some 50 miles, and it is stated that the received signals were fairly loud, although the articulation was not good because of the type of microphone supplied.

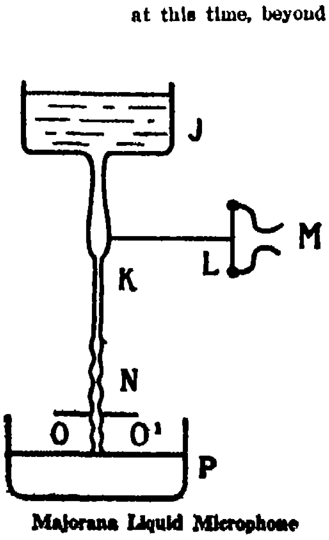
A few years later the handicaps of using the arc and microphones, which had before been pointed out by some few engineers, became generally appreciated. Since that time efforts in wireless telephony have been mainly toward the elimination of these troublesome elements. Majorana in Italy has devised an ingenious form of modulating transmitter in which a moving stream of conducting liquid is used instead of carbon granules as a resistance changing device. The arrangement is shown below. It is possible that recent forms of this apparatus may prove suitable for commercial service, because good results have been secured experimentally. Up until the last year or two, little other new work of striking importance had been reported.

At the present day, however, development of commercial radio telephony is being pushed forward in several quarters and, fittingly enough, the greater part of the work is going on in the United States where wireless telephony originated. About a year ago the Marconi Company telephoned messages from New York to Philadelphia using what is understood to be the special arc and microphone apparatus of a Western investigator, but concerning which no details are obtainable. Also Dr. D. G. McCaa, of Lancaster, Pa., equipped a coastwise steamer with a telephone of his own construction and succeeded in talking by radio to other ships and to shore stations over distances sometimes as great as 150 miles, when transmission was reported to be "fairly good." Dr. McCaa advises that he is unable to furnish information as to his apparatus at this time, beyond stating that from three to seven amperes were used in the antenna circuit, that a special microphone capable of handling these currents for periods of 20 minutes has been devised, and that the generator of oscillations has no moving parts and is "fool-proof." He also implies that the generator produces sustained trains of waves.



Poulsen radio telephone transmitter circuits

The direct current dynamo A supplies the arc C through choke-coils B, B¹. The arc converts the energy into high frequency currents in the condenser D and coil E, which induces forced oscillations in the secondary coil F. This is connected to the aerial wires G and through the microphone transmitter H to the earth at I



Majorana Liquid Microphone

Conducting liquid runs from tank J through nozzle K to receptacle P. K is altered by vibrations of diaphragm L when spoken against at M. Fluctuates in size at N and resistance changes between O, O¹

The steamship "Vaterland" is equipped with a new type of wireless telephone built by the Telefunken Company according to the plans lately proposed by Graf von Arco and his assistants. In principle this apparatus is similar to that used with the first 80,000 cycle radio frequency dynamo though the method of securing the high frequency alternating current is somewhat different. Instead of using a single generator which directly produces current

of 80,000 cycles or so, the Telefunken telephone includes a dynamo of lower frequency, from which the current is taken to a series of special transformer windings, each arranged to double the frequency of the electrical energy supplied to it. Thus, if the dynamo produces 8,000 cycles, after the first transformation the current will have 16,000 cycles per second. Succeeding steps will give respectively 32,000, 64,000 128,000 and 256,000 cycles, which last quoted rate would give good radiation from a ship's antenna. This frequency multiplying method is rather uneconomical, since power is lost at each transformation, but the scheme makes it possible to secure the desirable very high frequencies of current from dynamo machines of quite simple design. In the "Vaterland" telephone, modulation is secured by dividing the current energy between a large number of microphones, all operating together, each of which controls a part of the generator's output. No information as to distances which were actually transmitted with this outfit is available.

Another experimenter in radio telephony at the present time is E. G. Gage, who has built and operated instruments working along the lines both of high group frequencies and of *sustained waves*. His attention has been for the most part confined to the production of simply operated instruments suitable for use over short distances, in which efficiency is sacrificed to reliability. One of the photographs shows a microphone and control panel which is manipulated much as is the ordinary automatic line telephone. The act of removing the receiver ear pieces from the hook on the left starts the transmitting generator and in less than half a minute thereafter the apparatus is ready for talking. The two handles at the right permit tuning to various wavelengths for selection of desired stations, and the telegraph key is used for signaling Morse letters to "call" or attract the attention of the station to which it is desired to speak. The modulating transmitter is of a special carbon microphone form designed to carry 1.5 amperes. Oscillators producing wave groups at rates as high as 24,000 per second have been used but for ordinary work a frequency of 8,000 groups has been found satisfactory. The best results were reached in tests at the Brooklyn Navy Yard, where an alternator such as illustrated herewith was used in connection with frequency multiplying transformers to produce sustained waves. This method is somewhat analogous to that of von Arco described before, but it is stated that Gage uses different arrangements in the detail of his instruments.

In some of Fessenden's early work it was shown that rapidly recurrent spark discharges, even at a rate below the upper limit of audibility, could be used as oscillation generators for radio telephony. Gage has recently been experimenting along these lines from a station on Long Island Sound, and by using a special polyphase 2,400-cycle generator with a small quenching spark gap, he has succeeded in transmitting speech some 90 miles. The generator illustrated is of ¼ kva output and is used with several quenching gaps sparking in rotation. A special multiple microphone is used in the alternator circuit, so that the power supplied and not the antenna current alone is modulated by the voice. It is found that good speech transmission can be had with spark frequencies of 4,000 per second or even less.

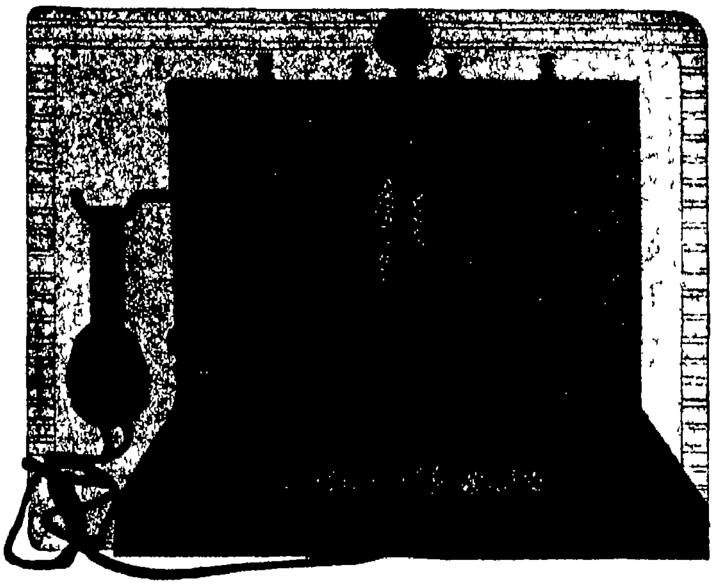
The National Electric Signaling Company, which owns and operates the Fessenden inventions in wireless telephony and telegraphy, has been developing commercial radio telephones at its Brooklyn plant. Modern forms of the original radio frequency dynamo, and of the high spark frequency oscillator are used, with special modulating relays for control of the emitted waves by an ordinary telephone transmitter located either at the radio station or at a distant point connected by wire. Circuits and relays for the interconnection of line and wireless telephones have been evolved, and the work has proceeded in the direction of securing reliability of continuous operation at the highest efficiencies. In the way of actual accomplishments, with the low powered spark telephone (rating less than 100 watts in the antenna circuit, or a little less power than is used to light an ordinary 32-candle-power carbon filament incandescent lamp), easily understood speech has been transmitted from Brooklyn to New London, Conn., something over 100 miles, and to Long Island Sound steamers over 50 miles away. In these tests the receivers were equipped with the usual rugged "crystal" detectors and no amplifying apparatus was used.

This company has also developed a new radio frequency alternator for the direct generation of sustained waves having frequencies as high as 150,000 per second which is used in conjunction with simple telephone transmitters of the usual type for short distances. For distances upward of 100 miles a powerful type of modulating relay has been built. It is used either with the large high frequency alternators or the spark oscillators.

Within the past few months the Western Electric Company has announced some startling feats of long distance radio telephony. As was pointed out above, increasing the possible transmission has required the development of modulating apparatus capable of controlling comparatively large amounts of high frequency electrical power. Distance of communication may also be increased by using very delicate receivers, since less received power is then required to produce a clear indication. By combining these principles wireless speech has been transmitted from Arlington across the Atlantic ocean to the Eiffel Tower and across the American continent and Pacific ocean to Hawaii. No authorized figures as to the amount of power radiated or controlled are available but the input to the aerial at Arlington has been stated to be about 20 kw. It is especially interesting that instead of generating the continuous oscillations of this power and then modulating them by rugged and effective modulators a small high frequency current is understood to have been produced and modulated by an ordinary microphone. The speech carrying but feeble current was then passed through a series of amplifiers until the final great power of some 20 kw. was reached.

At the receiving stations very sensitive magnifying apparatus was used so that far less power was required to cover the great distances than would have been needed to operate the ordinary receivers. This condition of course, rendered the transmission subject to interruption by atmospheric interference as stated in the press reports of the tests. By use of the several forms of telephone relays which the Western Electric Company has developed during the last year it was found possible to interlink the wire and radio telephone systems. Thus between New York and San Francisco two way conversations could be held the path being by wire to Arlington wireless to Mare Island, Cal. and by wire back to New York.

It would seem that wireless telephony is soon to become a commercial reality in at least one of its natural fields to wit marine signaling where wires cannot be laid and where it is inexpedient to keep trained telegraph operators on duty. The fact that speech transmission by radio is distortionless, or in other words that the voice is transmitted by wireless without the loss of articulation which proves so troublesome in line telephony indicates that the radio will ultimately find use as a trunk connection for linking widely separated line exchange systems. Before this can be realized commercially, however it is necessary so to develop the generating and particularly the modulating instruments that continuous conversations can be held over 500 or more miles without failure on account of atmospheric or other interferences or through fatigue of apparatus. It appears that this point has not been reached, but since the need exists it is probable that some of the investigators who are attempting to extend the original work will in time reach satisfactory solutions of the several remaining problems.



Wireless telephone control panel

Lifting the receivers off the hook starts the sending dynamo. The meter shows the amount of current present in the aerial wires

Lloyd Espenschied, who installed the temporary radio-telephone station at Pearl Harbor, Hawaii

The Man Who Heard Washington in Hawaii

So wonderful have been the recent successes of the wireless telephone apparatus with which communication was established between Arlington near Washington D. C. and Darien Paris, San Francisco and Honolulu that the minor yet interesting details have been overlooked. *Still, as these little details are* becoming known there is aroused a greater appreciation of what has been accomplished by the engineers in charge of the tests as a result of the increased knowledge of the handicaps which confronted them.

Not the least interesting of the minor details of the wireless telephone tests was the temporary installation of a receiving set at the Pearl Harbor yard near Honolulu. Lloyd Espenschied, the engineer to whom was assigned the task of receiving the wireless telephone conversation at that point found the regular aerial at Honolulu unsuitable for his purposes. Undaunted he set about to overcome this obstacle. He strung a small makeshift aerial between the smokestack and a water tank at the Pearl Harbor yard—an antenna so small as to make the final results truly remarkable especially when recalling the fact that his station was the furthest removed from the Arlington transmitter. To be exact, the aerial measured 250 feet in length and was supported between a smokestack and water tank measuring respectively, 100 feet and 80 feet high. The connection from the end of the aerial to the operating room was from the top of the smokestack to a pole 30 feet high just outside the operating room and approximately 400

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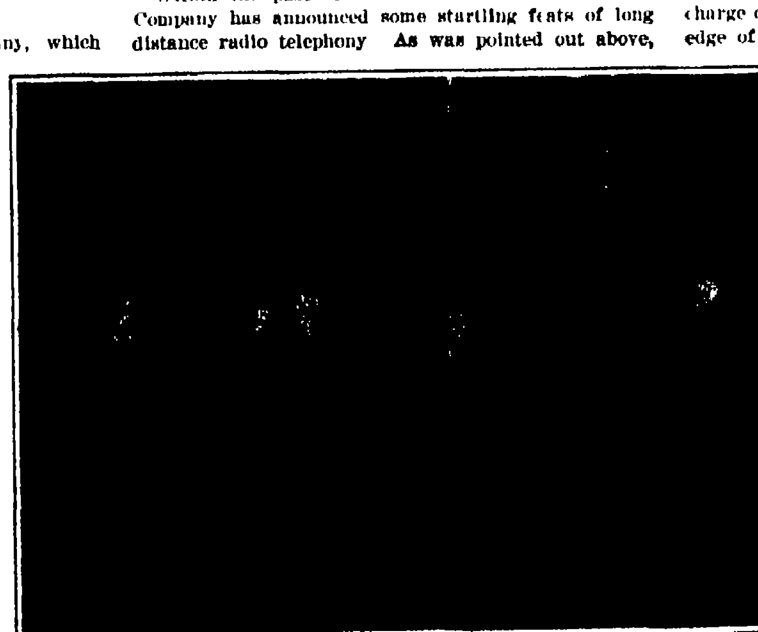


Forge shop of Pratt Institute, where Lloyd Espenschied utilized the steel smoke stack as a wireless antenna. The forge has since been torn down and replaced by a modern building

Strategic Moves of the War, January 7th, 1916

By Our Military Expert

AT last the expected activity on the Russian front seems to be developing in strength through a section of Austria Hungary so far little touched by the ravages of warfare, Bukovina, the most easterly possession of the dual empire.

As yet, it is impossible to definitely discern the great objective of the movement, for developments along the southern part of the line have not yet progressed sufficiently to indicate, but for purposes of analysis it is well to consider two principal factors in the general situation.

For a number of weeks, Russian regeneration of strength has been reported in the meager dispatches which have percolated in some way through the censorship which has held Russ news in its grasp. Much needed supplies of arms and ammunition, the thousand-and-one accessories needed for the prosecution of a campaign of stupendous proportions, have poured into the czar's domains through the gateway of Archangel and over the Trans-Siberian road, according to report. Fresh levies have gathered to the colors in replacement of the tremendous losses sustained during the late victorious Teutonic drive. Possibly, therefore, the launching of offensive activity is merely the termination of the period of preparation and the inauguration of general attack, made possible by the descent of bitter winter upon stream, morass and mud ridden road, so that *transportation and guns may move.*

On the other hand, diplomatic as well as strategic causes may lie at the base of the initiation of the offensive. Serbia, most of Albania and little Montenegro have been cleared of defenders, so that the roadway to Constantinople may be more surely safeguarded by control of a broad span of territory contiguous to it, as well as to demonstrate to wavering Balkan states that the promised punishment of Serbia was not forgotten—a veritable and impressive "rattling of the sword."

But the situation becomes more intense. Whether by accident or design, rumors of a proposed mighty Teutonic stroke against England, the financial backbone of the Entente, through her eastern empire, have been freely circulated with alleged details of probable strength thrown in gratis. Whether this is merely a sanguine shouting of "Boo" remains to be seen. Such a movement hardly seems to warrant belief in its probable success, but it certainly would succeed if sufficient forces could be found for the venture, in requiring the shift of Entente forces to meet its threat—a weakening of strength somewhere—possibly at Saloniki, where Teutonia still fears Entente influence which might result in arraying the armies of Greece against her.

Roumania, where it was feared that Teutonic diplomacy might prevail, let slip the opportunity offered her to declare for the Teutons and move against Russia. The shift of some hundreds of thousands of Russian troops to her borders is not believed to be the only reason Roumania refused to take the step. The Russ troops could hardly have been concentrated in time to meet the emergency if it had been a real one. There may therefore possibly be some reason for Entente belief that a convincing demonstration of strength may sway this country to ally herself with these powers.

Time will alone decide what actuates the present movement, it may be from either or both causes.

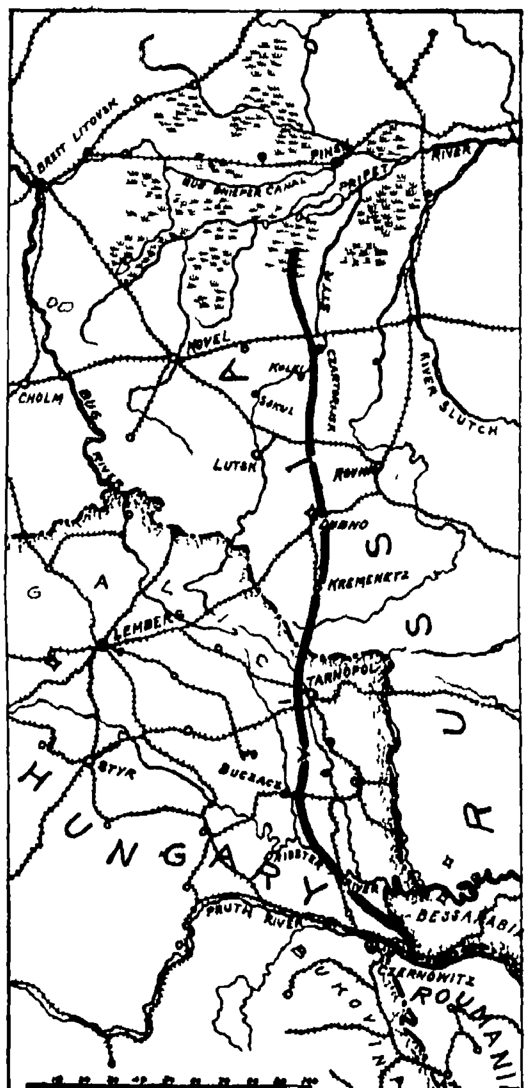
There are two other elements in the general situation which should be considered.

The defenses of Saloniki have been materially strengthened until, it is reported, that seaport city is practically invulnerable, being closely protected as it is by the great guns of the fleet. Additional troops are reported to be arriving, until the number now present is estimated at something like 200,000 or more. Italy has landed forces in Albania, that country of super difficult terrain, to assist the remaining yet defiant Serb and Montenegrin troops who emerged from the great recent drive, sorely battered.

It is then not impossible that in the course of time sufficient Entente strength may be gathered in the Balkans to undertake a forward movement—in combination with a downward thrust from Russia, perhaps with the aid of Roumania or through her territory by her consent, although the latter is hardly probable. Such a combined movement would partake of the nature of the action of great martial shears designed to cut cleanly communication between the Central Empires and Turkey, would at once vitiate any proposed movement against the British colonies and would require the undivided attention of Teutonia.

If such a severing movement is contemplated, it may be attributed to the recent formation of the so-called Entente general staff. It is no longer a secret that there have previously been dissensions between certain elements of the alliance, in which recrimination as to non-support has been freely bandied. This new advisory board, composed of strategists representing all the Entente powers, has acquired considerable authority and, it is generally believed, will have a material effect upon future operations. This board, which sits in France, must consider the entire situation, its purpose *is to so advise operations that from all quarters* support may be lent to the achievement of a given objective.

According to reports, some of the kinks have already been straightened out of the Russian line. Below Pripet, along the Styr, the Russ line has bulged forward a trifle to the north of Czartorijsk and south of the *same point toward* Kolki. Material gains have been reported toward Dubno and Kremenetz, while south of Tarnapol (a city of importance which was erroneously indicated as having been in Austrian hands in a recent article of this series) Russ gains toward Buczacz are apparently confirmed.



The southern Russian front

Near the confluence of the Sereth and the Dniester, the Russian line has crossed the latter stream and, pivoting on this point, is swinging steadily upon Czernowitz, and is already reported as commanding the city from heights to the northward.

During the first months of the war, in the course of which the first great Russian forward movement occurred, the Russian line pivoted upon a point near the Roumania Bokovina border, Dorna Watra, at the foot of the Carpathians, the southern terminus of the railway system which parallels the borders of Roumania. The crest of this tremendous range, at its nearest point, is about 75 miles from the present Russian position, and the forbidding wall of the mountains does not offer an easy mode of egress for any Teutonic troops which might be trapped in the Bokovina cul-de-sac should Russ success permit an effective movement upon the railway junction at Delatyn, which covers the railway pass of the same name about 20 miles to the southwest.

As a matter of fact, the southern extremity of the present Russian line is the point in the possession of the Entente nearest to Vienna, and Dorna Watra might well serve as the pivot for future operations, should the pendulum of fate warrant their undertaking.

The activity along the Styr suggests a movement against Kovel, a junction of importance on the main line from Lublin to Kiev. From Kovel, the Rovno railway and the line from the fortress city of Brest Litovsk, as well as the short line to Vladimir Volynsk, are controlled. Its possession should materially aid the Russian cause, although the strong position at Lutsk, on the Styr, must be taken before any degree of security of communication from menace can be entertained. The far reaching marshes which lie to the northward of the railway running eastward from Kovel, afford a considerable protection to the right flank of a Russian movement, although the present freezing weather in this section may materially increase the possibilities of movement against these lines.

The magnificent Teutonic organization has previously met each seeming threat, and it is only basing upon past performances to say that in all probability unimpeachable dispositions will be made to meet the present movement. Soon the public should be able to more readily decide the mooted question of Teutonia's waning forces, for should Czernowitz fall, as unconfirmed reports now state it has, and the Bukovina section be opened up to Russ strength, additional Teutonic troops will be necessitated to meet the extension of the line from its present terminus.

How much of the present activity is due to chance and circumstance is hard to say. The passing of the necessity for massing Russian troops on the Roumanian frontier may have offered an opportunity to strike with powerful strength against the nearest part of the Teutonic line. The very shift of forces seems to suggest that an understanding of some sort has been reached with Roumania, although, as a matter of fact, entrance into Roumanian territory may as easily be accomplished across its northwest frontier as across the northeast. A railway penetrates, in this section, from Bukovina into Roumania, striking the Sereth and paralleling its course down the valley. The Russ position may, therefore, be considered as materially improved from any standpoint, if developments prove that the province can be controlled. The river Pruth is no great obstacle for about 20 miles west by north of Czernowitz; it bends sharply and trends to the southward, thereby permitting the turning of any Teutonic position behind its lower reach which may be taken, if sufficient forces are operating against it.

The slackening of Teutonic operations in the Balkans seems to indicate that considerable forces have been withdrawn for utilization elsewhere. This may imply that knowledge is in the possession of the Central Empires that a sizable threat is brewing from Russia. If it develops that the heralded general Russian offensive has begun, in all probability there will be considerable activity exhibited from Saloniki and Albania, for it must be the endeavor of the Entente to hold every possible enemy soldier in position, that the line may not be reinforced.

The Queerest Industry—"Breeding" Maggots

OF all things on earth that would seem of no value for any purpose, to most persons nothing can appear more utterly worthless than maggots, the very thought of them is repulsive. And yet they are actually bred for the market in England where they are used as bait for trout and other fish.

There are several so-called "maggot farms" in that country and the wriggly, slimy worms are put up in cans and the better grades command a price of one shilling (24 cents) a quart.

The literature from one particular maggot farm styled the "Maggotorium," points out that the proprietor or maggot "farmer," has learned through fifteen years' experience "how to breed maggots of unsurpassable size and quality." Also that "he kills his own cattle and breeds only from beef and liver," enabling him to "guarantee the best maggots in the world"—all of which makes queer reading for American eyes.

Deepening the "New Waterway", Hook of Holland

A BILL, just brought before Parliament (the States General) by the Government, provides for the deepening of the fairway in the "New Waterway," Rotterdam, Hook of Holland, to a depth of 11½ meters, to a width of 100 meters. This improvement, it is estimated, will cost five million florins and will make Rotterdam accessible to the largest ships afloat—also men-of-war—and this latter possibility necessitates another outlay of five and a half million florins for defenses.

Rotterdam, as the greatest beneficiary, has agreed to bear one third of the cost of the improvement of the waterway.

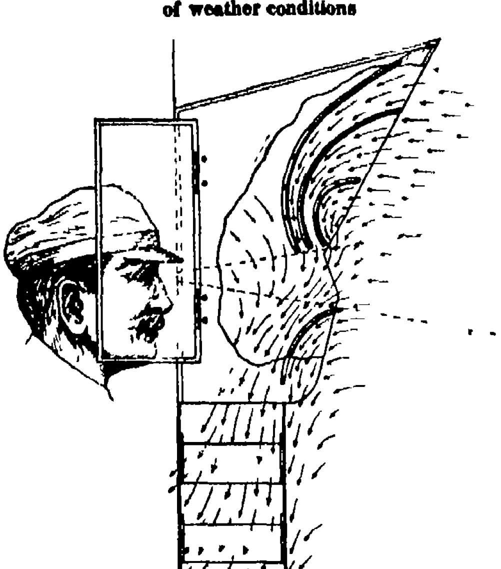
Wind-Deflecting Mask for the Use of Locomotive Engineers

A FEW years ago an engineer on a Canadian rail road was tried for killing several passengers as a result of a rear end collision between his engine and a passenger train ahead. His defense was simply that the weather was 40 degrees below zero, a 40-mile wind was blowing, the severity of which was greatly increased by the speed of his train and it was a human impossibility to withstand the cold long enough to get even a glimpse ahead from the open window. The other windows were so incrusted with ice that they might as well have been solid walls for all that could be seen through them.

The engineer won his own case on the strength of his testimony, but as a result of the case a mask was invented which eliminates the discomforts of looking forward in bitter cold weather and gives the engineer a clear and unobstructed vision, without even glass intervening. The result is secured by deflecting the air currents downward as they enter the mask and by forming a suction or draft at the bottom all air is drawn away from the engineer's face. So perfect are the results secured that a match held at the back of the shield burns steadily. The space between the deflecting partitions at the top and those at the bottom of the mask is open and it is through this space that the engineer secures a clear view of the track ahead.

The device is being generally adopted by Canadian railroads as a safety measure and for the greater comfort of their engine men.

Locomotive driver using the newly invented mask which assures a clear view ahead irrespective of weather conditions



Sectional view of the engineer's safety mask, showing its effect on air waves

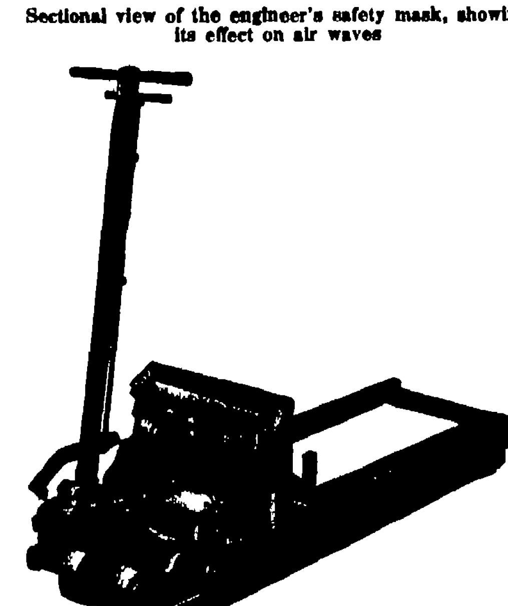
Apparatus for "Breaking In" Tobacco Pipes

WHILE it is true that a pipe smoker works up an affection for a pipe which he has made use of for a long time, it is likewise true that he would discard the old one sooner if it were not for the somewhat objectionable operation of "breaking in" a new one. It requires many days of use before the bowl of a new pipe has acquired a crust on the inner surface, which seems to be essential for the full enjoyment of the smoke. It is now proposed to sell the pipe already "broken", this task being performed by an electrical carbonizer which has just been patented. It consists of a heating element introduced into the bowl of the pipe and sealed in such a manner that an intense heat is applied to the inside of the bowl, after which it is ready to be placed into the hands of the smoker and put into active service by him at once, without any disagreeable preliminaries.

Labor-Saving Scale-Truck of Compact Design

THERE has recently been introduced a time- and labor saving device in the form of a combination scale-truck which is so constructed that when the material is placed on the platform on which it is to be transferred, it is weighed without being removed from its position. The scale-truck is simply run under the platform and elevated. The platform of the scale combined in the elevating truck, then rests against the platform holding the load and accurate weighing is obtained by the usual method, 200 pounds being weighed on the beam of the scale with an allowance of 50 pounds or more for tare. The total weight can be obtained, equal to the full capacity of the scale-truck, by the use of weights placed upon the counterpoise, as in regular weighing scales.

The combination scale-truck is also provided with auxiliary side bars that can be raised and will carry the load in the ordinary manner of the regular elevating truck, the load resting on these side bars, the strain upon the bearing of the scale portion of this device is effectively relieved. It is also possible to raise and elevate the combination scale-truck without interfering with the scale mechanism.



Combination scale-truck in which the scale and the elevating mechanism are independently operated

Newly Invented Circular Computer of Marked Accuracy

IN an endeavor to provide a computer of great accuracy for the use of engineers, Louis Ross a civil engineer of San Francisco has devised a new instrument that is at once compact simple, inexpensive and, most important of all, has an accuracy equivalent to that of a slide rule 100 feet long.

The new computer consists essentially of a graduated dial rotating under a slotted cover, a floating guide, and a slide mounted at the right of the slot. The dial carries a scale of numbers reading to five significant figures throughout. The slide carries a miniature of the dial scale reading to three figures. It coöperates with the dial, checks and points out the precise answer and locates its decimal point. For instant or approximate results the slide alone may be used in a manner which is claimed to be more direct and simple than the ordinary slide rule.

The variable graduations of the ordinary slide rule have been dropped completely in the new computer. The system of graduations is absolutely uniform throughout and is as simple as that of a 10-to-the-inch scale. The length of the scale, according to the inventor, is 120 times as great as that of the A and B scales in the ordinary 10-inch slide rule, although the instrument is only 8 inches in diameter. Its operation is comparatively simple and can be mastered with a little practice.

The new computer is made of metal throughout and the graduations engraved on silvered metal surfaces. It is slightly over 8 inches in diameter and weighs less than one pound.

Circular computer with an accuracy said to equal a 100-foot slide rule

French Bureau of Military Inventions

THE French government has organized a special department under the Minister of Public Instruction which will be concerned with examining inventions relating to the war. According to the *Journal Officiel* the object of the Bureau will be to afford a center for the now dispersed inventive talent which it is intended to make valuable by a concentration and effective organization. On this plan engineering and industrial mobilization will be completed by a scientific coördination. In consequence the Bureau is charged with examining the propositions of inventors and is to have all the valuable ones worked out to the best advantage, and it also undertakes all scientific researches which may be needed by the War or the Navy Departments. Suitable facilities will be provided for trying out all new apparatus which have a military bearing, and numerous official engineers and officers will follow this work, either at stated times or by a permanent connection with the Bureau of Inventions. This latter is to be controlled by an official commission composed of leading experts. Details of organization of this department will be published at a later date.

The Current Supplement

MUCH interest has been aroused in scientific circles by the remarkable model restorations of *Monster Extinct Reptiles* lately produced by the curator of this department of the National Museum, and the article on the subject, accompanied by a number of striking photographs, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2080 for January 15th, will be widely welcomed. *Possible Sources of Potash in America*, with notes on methods of recovery, is a timely article on a subject of increasing importance. *A New Idea in Electric Locomotives* explains some of the reasons for the type of motors used on the N & W road. A train pulled by the new equipment is illustrated. There is a brief description of *A Simple Wireless Telephone Set* with diagrams. *Radio-Active Substances in the Air, and Atmospheric Fog* is a study of atmospheric conditions of importance to the aviator. *Battle Aeroplanes* discusses the conditions encountered when fighting in the air, and their influence on design and tactics. An important paper deals with *The Periodic Law* and considers the relationship between the atomic weights of different elements and the places of the rarer gases in Mendeléjeff's table. A revised form of this table is given. An article that will be of interest and value to many is a list of the more important *Patents That Expired During the Past Year*. The paper on *The Physiological Importance of Phase Boundaries* is concluded and there are articles on *Printing Ink and Printing Paper*, *The Cause and Cure of Pellagra*, *Grafting Bone and Skin in a French Hospital*, *Buying and Selling Ore* and notices of *New Books*.

Scarcity of Wire Rope in Russia

IT is reported by the American Consul General at Moscow, Russia, that the petroleum producers of the Baku district are experiencing considerable inconvenience from the scarcity of steel wire rope. Previous to the war wire rope and wire to be made into rope by Russian manufacturers were imported principally from England. At present in consequence of the limited exports of steel goods from England steel wire rope of British manufacture has almost disappeared from the local markets and its price has arisen from 300 to 400 per cent. At a conference held in Baku to discuss this subject it was proposed temporarily to substitute for steel wire ropes, hemp ropes, which it may be possible to obtain from India. It was stated that Swedish wire rope has been found satisfactory for the local requirements of the petroleum industry.

Pulverized-Coal Burners on Steamships

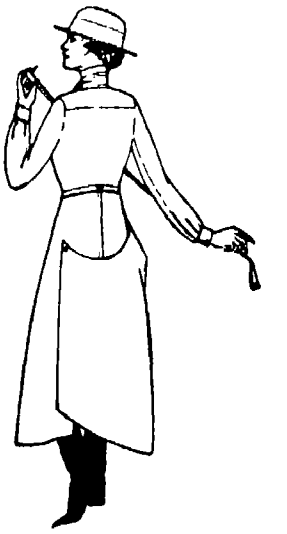
THE combustion of a "spray" of coal dust blown into the fire box by a blast of air is very nearly perfect, eliminating smoke, cinders and firing tools. A very high temperature is obtained actually melting the ash which runs down the walls of the fire box and is easily disposed of. The use of this device, so similar to oil burners where a jet of oil is blown in the boiler with a stream of air or steam is past the experimental stage. However it has not yet been applied to marine boilers so shipping interests are watching the experiments planned by the Pacific Coast Steamship Co. This company will charter a tug on Puget Sound and thoroughly test pulverized-coal burners. More heat is obtained from a ton of coal in this way and rather poor coal can be used. It is possible that if the tests succeed coal-dust burners may displace oil burners on many steamships.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

RIDING SKIRT I NARDI 73 W 47th St New York N Y The object of the invention is to provide a new and improved riding skirt arranged to insure a proper fit and perfect safety for riding on ladies side saddles and



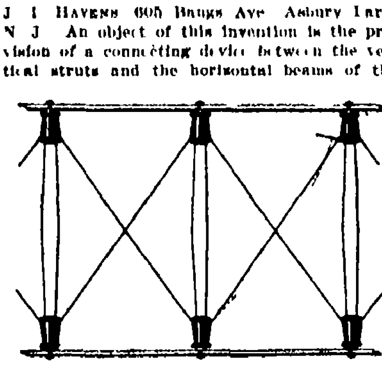
RIDING SKIRT FOR HUNTING

to prevent the habit from being caught on the pommel or other parts of the saddle in case the rider should fall or be thrown from her mount This skirt is built especially for hunting in the fields

HAT FLANGING AND FINISHING MACHINE T J MACDONALD 131 Nepperhan Ave Yonkers N Y This hat flanging and finishing machine is more especially designed for flanging and finishing women s hats and is arranged to accommodate different shaped hat blocks to enable the operator to conveniently reach every part of the brim to properly set flange and finish a hat

Pertaining to Aviation

AEROPLANE GUY WIRE TIGHTENER — J I HAVENS 605 Bangs Ave Asbury Park N J An object of this invention is the provision of a connecting device between the vertical struts and the horizontal beams of the



AEROPLANE GUY WIRE TIGHTENER

aeroplane structures of an aeroplane such connecting devices having novel means for fastening the guy wires thereto in such a manner that the wires can be quickly and easily tightened or released

Electrical Devices

ELEVATOR SIGNAL SYSTEM — J G SOMERS 267 Nichols Ave Brooklyn New York N Y This improvement provides a comparatively simple and efficient signal system which is relatively inexpensive to install and keep in operative condition thoroughly reliable and efficient in use and so designed as to be entirely automatic in operation irrespective of the number of shafts to which the system is applied

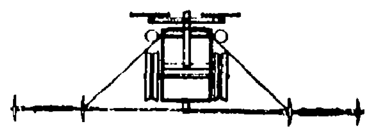
Of Interest to Farmers

CUTTING MACHINE L E PARMELEE, Hilliards Mich This machine is adapted for cutting standing corn and the like wherein a wheel support is provided having cutting mechanism at the front thereof for cutting the standing stalks in the row and wherein a traveling feed table is provided arranged to carry the material from the cutting mechanism to other mechanism for cutting the stalks in short lengths suitable for ensilage and where in a motor is provided on the support for operating the cutting mechanism and the feed table

STUMI CUTTING MACHINE — A L MOORE and C D MOORE 213 Hennen Bldg New Orleans La. The prime object of the present invention is the provision of improved cutting elements of the machine The invention is characterized by a centering cutter to enter the stump to center and steady the cutter head as it advances into the stump

GUARD MEANS FOR THE CUTTING MECHANISM OF BINDERS MOWERS &c — J M HAWKINS R R 8 Box 85, Carrollton, Mo The invention provides a cutting mechanism with a hingedly supported guard plate overhanging the sickle bar and operating to prevent clogging of the bar and adjacent parts with the grass or grain as the same is being cut said guard plate being so mounted as to be capable of being lifted to allow access to the parts normally covered thereby

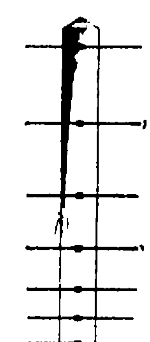
CORN PLANTER MARKER — G W RANDOLPH Winamac Ind This invention relates to corn planters and one of the main objects thereof is to provide means for marking a plurality of rows suitably spaced apart during the planting operation ready for guiding the



CORN PLANTER MARKER.

planter on its return trip back and forth over a field Another object is to provide means for compensating for inequalities or uneven surface conditions in an automatic manner in order to mark the rows clearly under all conditions

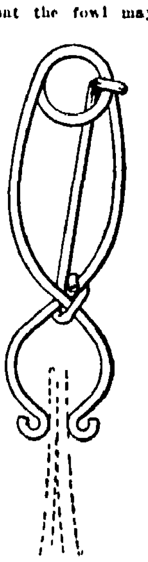
FENCE WIRE FASTENER — C B DUDEN Henryetta Okla This invention provides a fence wire seat block of such design that a fence wire can be securely fastened by means of a staple or the like to a fence post without danger of kinking or producing a bight in the wire and maintaining the wire out of contact with the wood whereby a rusting or



FENCE WIRE FASTENER.

corroding action where contact is made with the fence post when the wires are fastened by the usual method is prevented and further more the seat block is so designed that the wire can be easily and quickly unfastened by the use of a claw hammer engaging between the seat block and fence post

POULTRY WING HOLDER — R NYCE R F D No 1 Lansdale Pa This invention provides a device whereby the wings of a fowl may be held back and restrained in such position so that the fowl may be suitably



POULTRY WING HOLDER.

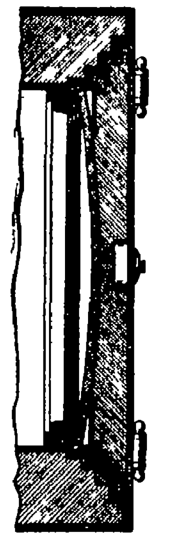
dusted with a germicide It provides a device of the type described in the nature of a spring clip which may be initially engaged upon the fowl s wings when they are folded back and a locking device for locking the clip member in position

Of General Interest

BOTTLE CAP — L H ROSSPECK, Bay Shore N Y The inventor provides facilities for sealing a bottle by means of a metal cap said cap being provided with means for clamping it firmly and tightly to the neck and providing means for easily removing it from the bottle by hand, the bottle cap being left in condition after removal, for reapplication to the bottle if desired

JOINT ANCHOR — E. C CORDES 1250 Edwards Road Ohio An object here is to arch the shank transversely and insert the shank in grooves connecting the openings so that the shank may be flattened in the grooves with the result that the sides of the shank will be embedded in the members at the sides of the grooves. By this means the shank as well as the plates will be secured relatively to the members

AUXILIARY DOOR FOR SAFES — H C LINK, 713 Colburn St., Toledo Ohio The object of this invention is to provide a door element or auxiliary door in connection with the ordinary door or doors of a safe so arranged as to prevent the safe from being blown



AUXILIARY DOOR FOR SAFES

open with nitro glycerine or other explosives A further object is to utilize the explosive force exerted against the said door element for releasing a third drill proof door element and jamming the same into a tapered seat on the door jamb

TABLE — G S TILLOTSON care of Sterling Grinding Wheel Co Tiffin Ohio The prime object of the invention is to provide means to tiltably support the table and positively hold it at the desired angle and to provide for the convenient vertical adjustment of the table as well as for revolving the table or securing it against turning movement

CAMERA — A I KELLOGG Portage Wis The present invention is for the purpose of enabling a person to manipulate a movable arm by means of a stylus instead of a pencil and provides means for guiding the operator when no visible means are made on the camera exterior or upon any substance on the camera Means provide for protecting the arm for rendering it immovable when not in use and for maintaining a stylus in convenient position

LIQUID CIRCULATOR — W T BONNER 30 Church St New York N Y The device has for its specific object the lifting of water from a dead or stagnant and therefore relatively cold zone within a boiler to an elevated zone of higher temperature whence the water may be conducted by gravity flow to any other point within said boiler and at the same time absorb sufficient heat units to increase its temperature, approximately to that of the steam within the elevated zone

PAINT AND VARNISH REMOVER. — H BIRCHALL 57 Charles St New York N Y The object in this case is to provide a composition of matter to be used as a paint and varnish remover which can be cheaply manufactured is practically odorless and when applied quickly removes paints and varnishes from woodwork metal structures and other articles and materials

LITTER AND COLLAPSIBLE FIELD COT — A LUBIA 920 Independence Boulevard Chicago Ill An object here is to provide certain connections between the lateral braces of the frame and the legs thereof utilized in the cot formation whereby the legs will be collapsed to positions adjacent and along the side bars of the frame by the collapsing movement of the lateral braces when the frame is folded

PROCESS OF PRODUCING SOLUBLE SALTS OF POTASSIUM AND ALUMINUM — M F COOLBAUGH Address Schrader & Lewis Rapid City S D In the present patent the invention has reference to improvements in processes for producing soluble salts of potassium and aluminum from silicious and argillaceous earths rocks or minerals in which compounds of these elements exist in an insoluble form

PROCESS OF PLATING CAST IRON OR STEEL. — F MOENCH Rushville Ill An object here is to provide a process of plating cast iron or steel with aluminum so that the latter is firmly secured to the surface of the iron or steel It provides a process which may be readily carried out without the use of expensive apparatus.

Hardware and Tools

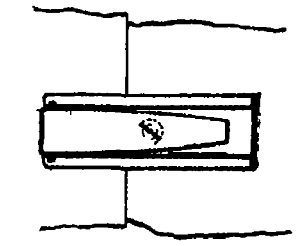
SAFETY TAP AND REAMER WRENCH — J DONNER, 542 Howard Ave Brooklyn, New York, N Y This invention relates to tools and particularly to the handle of tools, as for instance, the handle of tap and reamer wrenches, and the object is to provide means for connecting the handle with the wrench so as to eliminate the chances of breaking the tool in the wrench

RAKER GAGE. — R. E. GOSSON, R. 4, Box 82, Mt. Vernon, Wash. This invention provides a device having a gage clip for use in connection with the sharpening operation and a useful gage for use in connection with the swaging operation, all of which parts are combined in a single device which may be readily manipulated and accurately adjusted and which permits of an unobstructed view at all times of the work being done

Household Utilities

HEATING STOVE. — S M FORD, 1924 Grove Ave, Des Moines, Iowa. Among the objects of the invention is to provide a heating apparatus adapted especially for the use of kerosene as a fuel and comprising a drum with in or below which are adapted to be arranged one or more burners to which the oil is fed from a tank supported outside of the drum

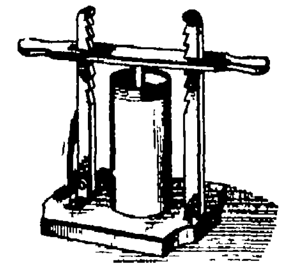
WINDOW BUTTON — G V BRATZEL Hebron, N D The invention relates to a device for fastening a storm window or a window screen in a window frame and more particularly relates to a device for the indicated purpose in which is included a box like body adapted



WINDOW BUTTON

to be pivotally mounted on a window frame to be turned to a position to overlie the window screen or storm window, the body having relatively yielding top and bottom members, there being a cam lever arranged to act on the separable members to cause the same to tightly press against the screen or storm window

HAM PRESSER AND COOKER — C BUTZ 418 W 7th St Muscatine Iowa The object here is to provide a device adapted for holding a ham during the cooking thereof and having means for subjecting the ham to a continuous yielding pressure during the cooking, to force



HAM PRESSER AND COOKER.

the hock end of the ham into the body thereof during the cooking to lessen the shrinkage of the ham and to save the loss of the hock end of the ham and wherein the ham is cooked with its natural flavor requiring no attention during the cooking and wherein a single utensil will serve for hams of various sizes.

CLOTHES LINE SUPPORT — L F RENAULT and C J DRAGO Address the former, 788 Madison St Brooklyn New York N Y The invention relates to clothes line supports and has particular reference to that class of such devices as are intended for use in apartment houses or the like where the clothes to be dried are hung from windows along lines leading to distant posts or other supports

Machines and Mechanical Devices

SAW FILING MACHINE. — H. I HANSON, Summit, S D The invention provides a machine having means for closely and accurately acquiring adjustments of pitch depth and angle whereby the file may be made to accommodate itself to the variations in the teeth of different saws and whereby exact and uniform work may be done on the saw teeth.

MEASURING FUNNEL — R. DE LA ROSA, 2 and 4 Stone St, New York, N Y An object here is to provide a valve whereby the funnel may be closed against the passage of liquids therethrough The invention provides means for actuating said valve from open to closed position after any desired quantity of liquid has been passed through said funnel

AIR PUMP — J A DREEHOUSE and F L DREEHOUSE Box 177, Laramie Wyo. The invention relates to air pumps and provides reversing means for the steam pistons of such pumps the invention being particularly designed for use in connection with conventional pumps, as the Westinghouse or New York pumps, to dispense with the usual reversing rod and with the tappet plate which cause so much trouble at present.

FORMING CHARGING, AND REMOVING DEVICE FOR BAKER S OVEN. — A STREIT, 85 Pitt St., New York N Y This invention provides a device more especially designed to enable a single operator to control the feeding of the matzoth from the forming and cutting machine into carriers mounted on the reel, and

to automatically control the discharge of the baked articles from the carriers.

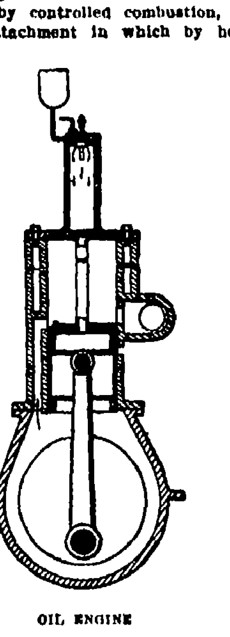
IRONING MACHINE.—R. G. McKay, Strathclair, Manitoba, Canada. The machine is operated by power and the iron is guided by hand. The purpose of the invention is to facilitate the guiding of the iron and to give the operator greater control over the same also to provide means for rendering the various parts of the machine readily accessible at all times.

PROPELLING DEVICE FOR TYPEWRITER CARRIAGES.—J B Bowen, Lumberton N C This inventor provides a device by means of which the carriage may be placed under tension so as to move forward in the act of writing but which may be instantly returned to its original position He also provides a device in which the return of the carriage to its original position is effected by means of a spring or similar tension device thereby returning the carriage always with the same velocity or speed

ANIMAL TRAP—A Salop, 3914 39th Ave Oakland Cal This invention provides a trap having a pair of jaws carrying barbs movable one toward the other by spring action the means for setting one of the jaws against the tension of the spring adapted to be tripped by contact of the rodent with the setting means, or by contact of earth thrown by the rodent on the setting means, whereby to trip the same and allow impalement of the animal upon closure of the jaws

Prime Movers and Their Accessories

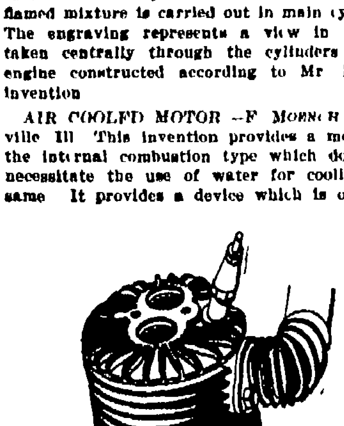
OIL ENGINE—Harry T Rauer Ashtabula Ohio This invention provides a means of utilizing for power oils in various refined or crude state by controlled combustion, in an engine or attachment in which by heat of



OIL ENGINE

compression of a mixture of oil and air vaporization and ignition of oil ensues with partial combustion means being provided whereby the further and complete combustion of said inflamed mixture is carried out in main cylinder The engraving represents a view in section taken centrally through the cylinders of an engine constructed according to Mr Rauer's invention

AIR COOLED MOTOR—F Morris Rushville Ill This invention provides a motor of the internal combustion type which does not necessitate the use of water for cooling the same It provides a device which is of light



AIR COOLED MOTOR

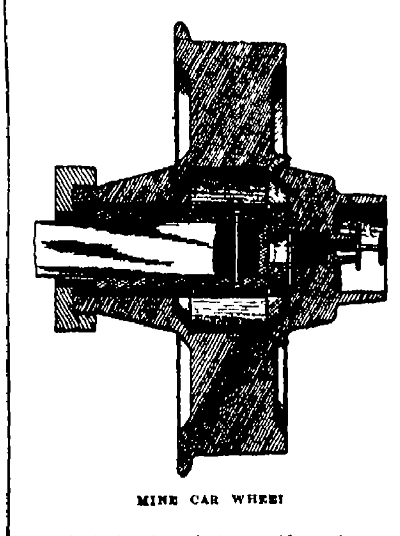
weight, owing to the use of aluminum for the radiating surface It also provides a motor or engine having means for rapidly radiating the heat developed on the interior of its cylinders owing to the novel construction whereby aluminum forms the greater part of the heat radiating and conducting medium

Railways and Their Accessories

AUTOMATIC GATE.—W H, Jay Laplant S D The invention provides gates for use at railroad crossings, wherein a plurality of similar gates is provided adapted to be arranged on opposite sides of the crossing and each comprising a frame having a passage adapted to register with each other and with the crossing to permit the passage of vehicles and the like, the gates being mounted to roll into and out of the passage and wherein operating mechanism is provided for permitting the gates to be simultaneously closed and opened by a moving train coming from either direction toward the gate

AUTOMATIC TRAIN STOP—M B Bulla, Hotel Chreptola El Paso, Tex This invention provides a construction including the devices carried by the locomotive and comprising an alarm gong connections with the train air line and main and auxiliary electric circuits serving first to sound the alarm and subsequently to open the train line when the engineer through carelessness or incapacity allows his locomotive to run past a danger point

MINE CAR WHEEL—J Coan, Baldwin Colo This invention relates more particularly to an improved mine car or similar type of wheels running loosely on an axle One of

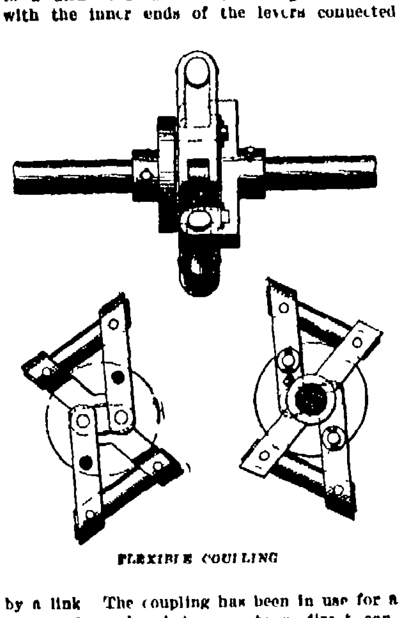


MINE CAR WHEEL

the principal objects is to provide an improved means especially adaptable to mine car wheels having a fixed axle for locking the wheels with the axle at will to prevent accidental movement of the car along a track

Pertaining to Vehicles

FLEXIBLE COUPLING—A N Clarson Sheridan Ill The coupling is constructed with an arm secured to one of the shafts which is rotated by members with which it is engaged at its ends the members being secured to the outer ends of the levers fulcrumed to a disk secured to the driving shaft and with the inner ends of the levers connected



FLEXIBLE COUPLING

by a link The coupling has been in use for a year and employed to operate a direct connected dynamo running at 2800 R P M and the two shafts do not have to lie parallel or meet centrally It will be found advantageous for use for automobile magnetos and dynamos, between engine and transmission and in direct connected farm lighting plants

AUTOMOBILE SIGNAL—J Nicholson Address Purcell Rowe, Attorney Monadnock Bldg San Francisco Cal This signal is to be operated by the chauffeur at will to indicate the intention to turn to one side or the other and to indicate the direction in which it is intended to turn wherein a plurality of signals is provided for each mud guard, capable of being moved into and out of operative position and electrically controlled to be moved into operative position and to be held in such position and wherein spring operated mechanism is provided for automatically releasing the signal after the lapse of a predetermined length of time

Note—Copies of any of these patents will be furnished by the Scientific American for ten cents each Please state the name of the patentee, title of the invention, and date of this paper

Notes and Queries.

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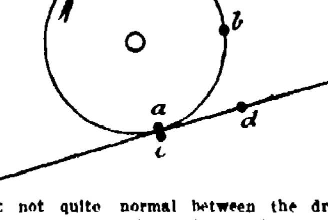
(14006) W H asks A locomotive with steam turned on fully is tugging at a heavy train on a steep grade The tractile force of the locomotive is exactly balanced by the various opposing forces the net result being that the train is stalled—that is poised in stationary position—and so maintained by tension of steam in the cylinders A rain comes up (or down) and wets the rails whereupon the locomotive driving wheels begin to slip and to spin rapidly so that the train retrogrades a negligible distance The engineer directs a stream of dry sand upon the rails He manipulates the flow of sand so skillfully that he renders the friction nearly



but not quite normal between the driving wheels and the rails That is by means of the sand he reduces the speed of the wheels nearly to zero so that a given stretch a b, of the wheel circumference makes a sliding rotary contact with a given stretch c d of the track rail the distance c d being a little shorter than the distance a b say in the ratio of 1 to 2 In other words the wheels tend to make a few superfluous revolutions for a given length of track What is the effect upon the train? A In the query which you send us accompanied by a sketch of the position of a locomotive driving wheel we note that you fixed the center of the wheel at a right angle to the point c of the rail when the point a of the wheel is in contact with the point c of the rail Later when the point b of the wheel is in contact with the point d" of the rail the center of the wheel is at a right angle with the point d of the rail The center of the wheel has therefore advanced a distance c d along the rail The entire train must have been affected by this advance of the locomotive on the rail

(14007) T F D asks I desire a little information to settle an argument Did the Twentieth Century begin 1900 or 1901? Our postmaster and several prominent business men were mixed up in this and they were about equally divided One side took for example the birth of a child the child is one year old just as soon as you write one year it has already lived its entire first year A The year 1900 was the last year of the nineteenth century and the twentieth century began on January 1st 1901 immediately after the instant of midnight The matter is very simple Suppose you were counting out buttons in parcels of 100 You count 1, 2, 3, etc The 100th button belongs to the first parcel If it were put into the second parcel there would be but 99 buttons in the first so also the 200th button ends the second parcel and the 1900th button is the last button of the nineteenth parcel With years the case is in no wise different The closing year of a century gives the name to the century The year 1900 was the last year of the nineteenth century The same is true of a child A boy is not ten years old till he has reached the tenth birthday after the day on which he was born His twentieth year belongs to the second decade of his life This was fully discussed in the Scientific American in 1900 and 1901 and none who were our readers at that time need be in doubt on the matter

(14008) R B S asks Is it true that sunlight affects the transmission of wireless signals? A It is common knowledge that wireless stations do not work to the best advantage in bright sunlight The greatest distances are covered at night or even on cloudy days. While several theories have been offered from time to time in the way of explaining the cause of the decreased efficiency of wireless waves in sunlight it is generally held that a convincing explanation is still forthcoming

(14009) W S G asks Would you kindly inform me what Newton's Laws of Motion are under Notes and Queries? A Newton's Laws of Motion are the basis of all the discussions of motion in physics Every text book of physics contains them The laws are sometimes stated as follows 1 A body continues in a state of rest or of uniform motion in a straight line, unless compelled to change by some external force 2. A given force produces the same effect whether it acts upon a body at rest or in motion whether it acts alone or together with other forces 3 Action and reaction are equal and opposite in direction

(14010) D S C asks In your issue of October 2d you explain to correspondent W H that the earth carries with it its atmosphere and thus causes a balloon to descend in the vicinity from which it arose This raises another question to which I invite your attention Scientists tell us that outer space is filled with an element to which they have given the name ether Since in our orbit around the sun of about 580 million miles we are moving at the rate of approximately 70 000 miles an hour is it not evident that no matter how tenuous this alleged ether might be our progress against it at such tremendous velocity would not only sweep away our atmosphere but everything else movable on earth—nay would not a 70 000 mile speed blow the very globe itself into dust utterly annihilating it? Moreover must not this imagined ether offer some resistance to the passage of the earth and would not such resistance—no matter how slight it might be annually—have long ago caused the earth to cease its revolution around the sun And yet we find that in making this vast journey there is not now and presumably never has been the variation of so much as one second From these facts I reach the conclusion that the ether theory has no basis and that interplanetary space is absolutely vacant despite the commonly accepted opinion that nature abhors a vacuum A We note your reasoning regarding the resistance the earth must receive from the ether of space but are we regret to say not able to accept your conclusions The fact is that the earth shows no retardation in its orbit The conclusion is that the ether is vastly more tenuous than any other substance of which we have any knowledge This contrasted with the immense weight and enormous velocity of the earth makes the resistance an infinitesimal quantity and the earth shows no decrease in its orbital velocity Even the enormous resistance of the tides to its motion of rotation has not lengthened the day within historic time The ether theory is firmly fixed in science and the objections which you urge against it have been fully considered by scientific men

(14011) C L H asks I am desirous of finding out if the different hardnesses of copper remain of the same hardness after they are put through an electroplating process and deposited on other metal A We see no reason why copper deposited by electroplating should not be all of the same hardness no matter how hard or soft the plate from which the copper is deposited The molecules pass through the liquid form or the ionic form and will all be alike in constitution when they are deposited from the solution Copper is hardened by physical means and when heated again resumes its soft condition

(14012) R T L asks I would now like to get some of the common names of the different chemical substances For instance chemical name Potassium bitartrate common name cream of tartar Have you any book giving the common and chemical names? If so please give price and title A We recommend and can supply you with Newell's Descriptive Chemistry for $1 30 postpaid which contains many of the common names of chemicals such as muriatic acid blue stone aqua fortis oil of vitriol and many others A great many chemicals have no common names and you must use the real name or have no name at all The large dictionaries probably contain all the common names of chemicals The elementary text books of chemistry are more likely to give common names than the higher class of books It is not desirable to have two or sometimes more names for the same thing

(14013) S P asks As a reader of your paper and one who is very much interested in scientific knowledge I desire to appeal for the help of your worthy journal to kindly give me any information within your power on the following question How did the original nebulae of gas supposedly the sun receive its rotary motion? I have already hunted for an explanation to this question in many different directions and from men of high scientific authority, but all of them seem to know no more than I I have even spent hours consulting the famous "Laplacian Nebulae Hypothesis only to find this answer The nebulae was endowed with a slow rotary motion A If you will reflect a little we feel sure that you will realize that no one can know how the original nebula obtained its rotary motion Who was there to bring the story? The fact that all the planets move in the same direction and all of the moons which were known in the time of La Place that the sun and all the planets turn on their axes in the same direction was a sufficient reason for saying that the original nebula rotated in the same direction at the time it began to throw off the planets There is no one who can give a reason why You will have to be content with the fact as it is Science has its mysteries as deep as those of theology

A Sixty-Cycle Million-Volt Transformer

(*Concluded from page 77*)

that very peculiar sensations are experienced by persons who may be standing therein

When the net is charged and the gap is open so that no discharge takes place to ground the results are quite remarkable The net and all connecting wires show luminous with corona, while intense brush discharge occurs at all corners and at dead ends The wires hum and the building vibrates to the tune of 60 cycles. The iron bolts become highly charged and if one is grasped by the bare hand a sensation is produced which is similar to that experienced when handling low tension current at the same frequency

The electric field is most dense directly beneath the net and it is here that the results are most spectacular If the hand is held in the air above the head a brush discharge takes place from the tips of the fingers If a hat is held in the hand sparks can be drawn from the band of the hat Metallic objects such as umbrellas and hair pins become exceedingly obnoxious to their bearers Sparks can be drawn between various people, the length depending upon the relative difference of potential of each person with respect to the ground A metallic object thrown into the air is charged and becomes luminous In candescent lamp bulbs held in the hand glow with the pale blue light characteristic of a discharge through a medium of rarified air Sparks several inches long can be drawn from metallic plates supported in the air a few feet above the ground This discharge can be taken into the body, but the sensation is rather unpleasant. The current is sufficient to kindle paper if the latter is pierced by the spark for a considerable time The odor of ozone permeates the atmosphere in the vicinity of the apparatus.

Similar results on a much smaller scale, have been attained with currents of less magnitude, but these are claimed to be the first experiments conducted with such low frequency high tension current They have proven the practicability of the Thordarson type of transformer construction and have paved the way for further investigation of the transmission of power over great distances at unusually high tension

Probable Perception of Invisible Light by Some Animal Species

(*Concluded from page 81*)

fully absorb the rays while other yellow zones powerfully reflect them—for example common squash flower and dandelion flower

That in both butterflies and flowers the only pigment which reflects the ultra violet should be yellow seems to be something more than a mere coincidence but we utterly fail to see the significance of the fact if it has any On the other hand, it seems to us that there is no good reason why the presence of an intense ultra violet color on the wings of many butterflies should receive an interpretation different from that so far given to the presence of other colors visible to us, its *raison d'être* may be to favor the union of sexes or to protect those butterflies which feed on ultra violet flowers If it be borne in mind that the enormous compound eyes of butterflies fill most of the head while a pair of supplementary simple eyes, the use of which is not known, generally occupies the top of the head, it seems no wonder that such a complicated visual apparatus should be in some respects, more complete than ours and perhaps sensitive to wave lengths somewhat shorter than the short wave extreme of our visible spectrum

The sensitiveness of butterflies' eyes to the other extreme of the spectrum, i. e., to the extreme red and beginning of the infra red, seems much less probable We have shown that, in the extreme red region of the spectrum, all flowers are white, that is to say, they uniformly and powerfully reflect light of a wave length greater than that corresponding to the red. Far from being useful to butterflies, the main result of a keen perception of

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great wave lengths would be a considerable damping of the chromatic differences which allow each species to select, among flowers, those best adapted to their digestive organs.

The first photograph was made on an orthochromatic plate, with a weak yellow screen It accordingly shows the butterflies about as they appear to the eye that is, with each color keeping its relative luminosity The third photograph, on the other hand, was made in direct solar light with Wood's filter, on plates sensitized with alizarine blue and silver nitrate The second photograph was made in diffused sky light with Foucault's silver film deposited on a quartz lens

Biologists desirous of studying the effect of invisible solar light on living beings will find in the silver film an ideal filter as it cuts out every radiation except *the very last short wave lengths contained in solar light at sea level* The visible spectrum begins at about 7,950 A U with the extreme red, and ends at about 3,934 A. U with the beginning of invisible ultra violet. Solar ultra violet at sea level ends with wave length 3 100, the atmosphere being opaque for shorter radiations The silver film is transparent precisely for radiations 3,150 3,250

The Man Who Heard Washington in Hawaii

(*Concluded from page 83*)

feet distant from the stack, at right angles to the span Crude as obviously was this antenna, Mr Espenschied intercepted the radio telephone waves and heard the conversation between Arlington and San Francisco In all, a distance of 4 900 miles was covered between the transmitting aerial at Arlington and his temporary station

That Mr Espenschied's experience in installing a wireless telegraph set at Pratt Institute while a student served him to good stead is disclosed in the reminiscences of Samuel S Edmands, Director of the School of Science and Technology of that Institute The story is best told by Mr Edmands

"During the early months of 1909, Mr Lloyd Espenschied, who was then a student at Pratt Institute in the course in applied electricity, was engaged along with a number of other students and instructors in the making and installing of a wireless telegraphy outfit in the electrical laboratory

"Apparatus for the Institute's wireless station was in process of design and construction by the students and there arose occasion for testing certain parts of the receiving apparatus. At that time the aerial antenna had not been erected and it was necessary to find something which might serve as a substitute for the proposed test Mr Espenschied decided to try to utilize a steel smoke stack which rose above the roofs of the buildings, and was a part of the smoke exhaust system of the school's forge shop

"Mr Espenschied arranged his apparatus on the dead coals of one of the forges not in use and connected his aerial conductor to the steel hood over the forge No sooner had he applied the receivers to his ears and tuned the apparatus than he heard a wireless station in Philadelphia calling a station on the roof of the Plaza Hotel in New York City There followed a message addressed to Prof M I Pupin, of Columbia University famed for his inventions in the field of electrical communication, both with and without wires. This message Mr Espenschied wrote down and handed to one of his instructors Prof T H Morecroft who happened to pass at the moment on his way to Columbia University to attend a lecture by Prof Pupin. This copy of the message reached Prof Pupin before the arrival of the same message via the Hotel Plaza station, and Prof Pupin was greatly entertained by the account of how the message had been caught through the unconventional medium of a forge shop, and had through a rather remarkable circumstance reached him before its arrival through the regular channels.

"This incident is illustrative of Mr Espenschied's ability to surmount practical difficulties by utilizing unconventional

facilities, a characteristic which doubtless played an important part in his selection by Mr J J Carty, chief engineer of the American Telephone and Telegraph Company, to handle the Honolulu end of the recent remarkable demonstration of wireless telephony between Arlington, Va, and Pearl Harbor, Honolulu. It is especially interesting to note that the account of this demonstration given by the *Western Electric News* should relate the meeting of another emergency by the substitution of a smoke stack and a water tank for the usual supporting towers, which were lacking in this experiment which set a world's record in wireless telephony"

Industrial Preparedness for Peace

(Concluded from page 78)

problem of efficiency We know a great deal about the chemistry of material things but our knowledge of *human* chemicals is exceedingly limited In mobilizing our forces for industrial preparedness for peace we want no premature explosions, we want no sudden precipitation in our melting pot It would seem that the first principle of scientific management would be *coöperation.* Coöperation through *consent* and not *conscription* It is a human problem Largely common sense! The time has passed when we can impose upon men systems and devices, schemes and programs, without their understanding and consent We need, and we shall demand, coöperation in the mobilization for industrial preparedness. We must insist, however that that coöperation is attained through consent, and not by pressure We are mobilizing for prosperity, not mutinousness We can afford to set aside our ultimate ideals for the moment, forget our immediate differences, and take stock

The Problem in a Nut-Shell

DEFENSE

1 What are we preparing to meet?
2 Into what divisions are the forces of invasion naturally falling?
3 What is our defense?
4 What forces have we for immediate mobilization?
5 What forces have we in reserve?
6 What strategic points do we hold?
7 What strategic points are held by the invader?
8 What are our plans for defensive operations?

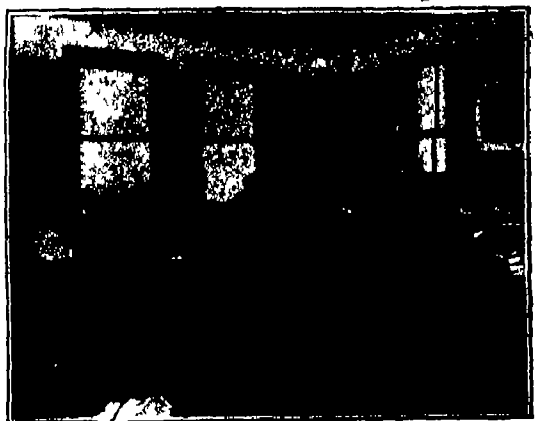
OFFENSIVE.

1 What will be the opportunities for industrial expansion?
2 What markets will be open through out the world?
3 What opposition will we meet?
4 How shall we meet it?
5 What support will we receive at home?

The Solution

There will be great diversity of opinion upon each and every point under discussion We hope to get men thinking about the problem and start analyzing their own position in relation to it as a whole We want men to take stock of their own opinions, to sum up their own experience and tie it in with industrial and economic history

Industrial Preparedness for Peace means efficiency of the highest order We are not to become slaves to the machinery of industry, but masters of the mechanism of the nation's business Our national efficiency shall not be measured in the terms of mere productive capacity, but in the sum total of human happiness we can get out of our opportunities. We are not preparing to die for posterity, we are preparing to live for posterity Industrial preparedness means preparedness to sustain the shocks of necessity The problem is economic, but not all economic. We desire to live peacefully, but not slothfully, we desire to trade with the world, but not through a hole in a Chinese wall We do not wish to live in the shadow, we demand a place in the sun, achieved not by military but by industrial effort.



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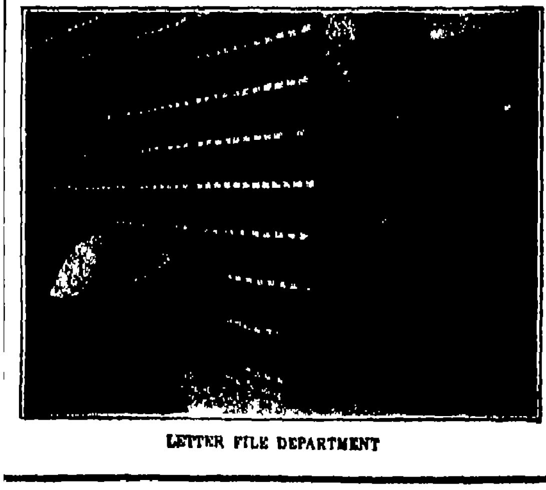

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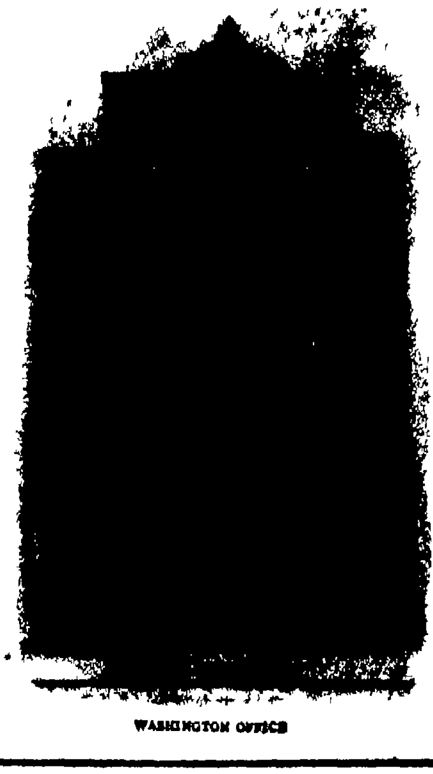

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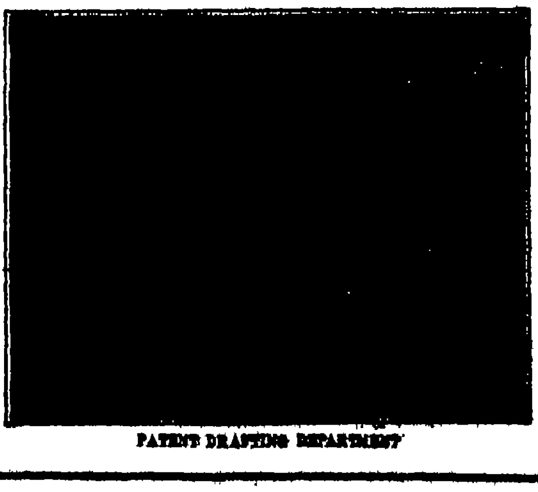

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SUBMARINE CREW EQUIPPED WITH SELF-CONTAINED DIVING SUITS CLIMBING UP THE CABLE OF A BUOY RELEASED FROM THE WRECK

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs

A Submarine "Curtain of Fire"

AT the opening of the great world war the submarine played so conspicuous a part as to gain for itself a reputation far greater than it deserved Since then we have not heard so much of its operations against war vessels, and there has been much speculation as to the means used to combat this most modern development of naval warfare.

Recently an account appeared in one of the daily newspapers of a high explosive shell developed by the British, which would not ricochet and which would detonate only on reaching a predetermined depth below the surface of the water According to the account a battleship fleet protected itself by a so-called "curtain of fire" The shells were rained into the sea along a line about two miles or so from the fleet and these shells would sink to a distance of about twelve feet under the surface before exploding The fuse was a capillary tube which drew up water into contact with a pinch of potash so that it was the sea itself that caused the shells to explode It was claimed that a wide area of destruction would be produced which would crush all submarines in the vicinity

It is never safe to ridicule an invention until a full description of it is obtained However, it must be self evident to any thoughtful reader that this newspaper account of submarine shelling must be taken *cum grano salis* In order to accomplish its purpose, the shell would have to contain a sufficient quantity of explosive charge to assume the function of a small torpedo or mine It would have to be of the proportions and weight suitable to be fired from a gun with the probability of obtaining the range desired Experiments have been made by our own Government with a shell containing a large amount of high explosive, but it was found impracticable to fire this shell to any great distance because it was not heavy enough to permit the generation of sufficient pressure in the firing charge of the gun before the projectile left the muzzle. If the projectile be made heavy enough to permit of its attaining the desired range, it would probably sink so fast when striking the water that it would be very difficult to gage a fuse which would detonate it at the proper depth. The newspaper account refers to the new shell as one that does not ricochet on the water This, of course, is not a property of the shell, for any shell will ricochet if it strikes the water at a small angle from the horizontal To prevent it from ricocheting, the shell should be fired at a high angle, as out of a mortar

As to the effectiveness of submarine shells there seems to be considerable misapprehension. When the shell is detonated under water a pressure is exerted, of course, in all directions, but a vent is found directly upward when the shell throws a column of water Theoretically, the destructive radius of the detonated shell would be no greater than its depth under the surface. In other words if the shell exploded at the depth of twelve feet it would not do any material damage to surrounding vessels unless within twelve feet of the shell From this it will be seen that in order to injure the submarine the shell must virtually graze the boat.

In order to produce the "curtain of fire" referred to, a very large store of ammunition would be required, otherwise the "curtain" would be very ineffective This would require large additional magazines in the battleships The use of this equipment would only come into play after the battle fleet's screen of scouts, torpedo flotilla and aeroplane service had been dodged or been put out of action This would be a desperate emergency indeed

Altogether the engagement of the battle fleet with a submarine flotilla would be such an unlikely contingency that dependence upon the present means of defense would be sufficient Owing to the great obstacles to be overcome in delivering the shell at the point of effective use, and owing also to the small radius of effective action of the shell, it is hardly to be expected that this method of submarine defense will get beyond the experimental stage

Should Science Teaching Be Reformed?

OUR English contemporary, *Nature*, in one of its recent issues, published some animadversions on the methods of science teaching in vogue at the present day, as compared with those of a generation or two ago. Whatever pedagogues may have to say in reply, it is certain that these criticisms will strike a responsive chord in the minds of many persons, them selves neither pedagogues nor men of science, who feel that they have not carried away with them from their own schooling just the kind of acquaintance with the sciences that they should like to possess.

The burden of the complaint may be gathered from the following extracts "Twenty years ago or so much more attention was given to the attractive side of science than is now the case. School science as at present taught, and as defined by examination syllabuses, seems to proceed on the assumption that every pupil is to become a skillful experimenter, or an original investigator, in the realms of Nature. . In their anxiety to impress pupils with a sense of scientific accuracy and cautious conclusion, advocates of the methods now in vogue have forgotten that it is even more important to present a view of science which shall be human as well as precise"

To make a long story short, *Nature* protests against the practice of focusing the attention of the average pupil, who is seeking a general education, upon a small part of the field embraced by each of the principal *sciences, with insistence upon a considerable amount of* laboratory work and other expedients for developing rigidly scientific habits of mind, in lieu of the old fashioned method of imparting a superficial knowledge of the science as a whole.

Nature perhaps underestimates the time that has elapsed since the old plan was in vogue. The present writer looks back twenty five years to a one-semester course in botany, taken in the high school of one of our large cities, during which he became quite expert in dissecting seeds and in staining tissues for inspection through the microscope, but at the end of which he had not learned to recognize at sight a single common wild flower Moreover, this method of teaching botany—which, for aught that it contributed to one's stock of interesting and useful information, might have been profitably replaced by the one employed by the late Mr Squeers (if memory serves us Dotheboy Hall botany consisted in weeding the garden, which at least got one in touch with Nature)—this lopsided method of teaching botany was quite an old story even in those days. Probably we must go back at least half a century to reach the time when nobody studied botany without acquiring a bowing acquaintance with the local flora, when a course in astronomy ensured the pupil a fair knowledge of the constellations, and even of the mythological stories that pertain to them, together with such picturesque (and *sometimes apocryphal*) episodes in the history of the science as the Papal excommunication of Halley's comet, when physics (then "natural philosophy") was not all formulas and problems, but was fraught with all sorts of necromantic marvels, from Rupert's drop to the Magdeburg hemispheres (tame, indeed, compared with the magic of radio-activity, electromagnetic waves, and what-not, available for making present-day physics a fascinating study, but so sparingly used for that purpose)

In short, with the marvelous expansion that has occurred in every branch of science, the means are at hand to-day for making elementary science teaching far more enriching to the mind, far more pregnant with valuable as well as interesting information, than it was in the days of our grandfathers—yet we have a strong impression that it is actually far less so

Let us not depreciate mental discipline—the fetich of modern pedagogy. It is well that our school children should have their minds trained by dry gymnastic methods, even as the fingers of the pianist are trained with five-finger exercises. But after the pianist has made a good beginning in "technique," he embarks upon the more attractive task of acquiring a répertoire. The study of science—in the case of the average man—too often never gets beyond the stage of five-finger exercises.

Of course there are two sides to this question Our only contention is that the rebound from the extreme dilettantism of the older methods of instruction has carried our science teachers too far in the other direction.

Utilizing Horses Slain in Battle

THERE has been an enormous loss of horses during the great war During the first period of the conflict there was little effort at utilizing the flesh and skin of the carcasses. The compelling idea was to get these [illegible] into the air, and [illegible] for myriads of flies. [illegible] thrifty German mind [illegible] economic value of flesh and hide, bone and hoof.

The question has been made the subject of an article by Mr. Heyking, the Director of the German Fisheries in the *Deutschen Fischereikorrespondenz*. This article bears the title "Horseflesh as Food for Man and Animals." Its author deplores the fact that there should be such a wide-spread and unreasonable prejudice against the use of horseflesh as human food. To our minds it seems probable that this prejudice is largely due to the sentimental associations which have gathered about the horse for untold generations as the friend and companion of man in times of peace, and his gallant and helpful comrade in time of war. Dr. Heyking, however, ascribes the feeling mainly to an instinct founded originally in religious prejudice. He says, as quoted in the *Kölnischer Zeitung* (Cologne): "The ancient Germans and Scandinavians esteemed horseflesh very highly, and the horse was the sacrificial animal most prized, its skull being nailed to house doors and roofs as a memento of the Feast of Freya. It was probably this connection with the old heathen sacrificial uses which caused the Christian priests to forbid the eating of horseflesh." While this may have been partly the reason for abandoning horseflesh as food, it seems likely that a more direct cause was literal acceptation of the Mosaic law banning as unclean certain animals. At any rate Pope Gregory III formally denounced the horse as an unclean animal for food purposes. Naturally enough the prejudice, however created, has become in the course of generations an instinctive repulsion in most people. In times of famine, however, hunger has often proved stronger than the prejudice Horseflesh was eaten freely by the hunger smitten populace in 1816-17 in Germany and Switzerland, in 1847 in Berlin, in 1866 in East Prussia, and in the siege of Paris in 1870

However, a strong feeling of aversion to this food still lingers, though many scientists including Prof. Esser of Göttingen, recommend it as a cheap and good popular food To promote its use Prof Esser advises that butchers and dealers should be required to keep it on sale, though separated and plainly labeled, just as kosher meat is kept separate, and margarine is separated from butter

Dr Heyking advises that battlefields should be searched for slain and mortally wounded horses, that they should be promptly skinned and the meat packed in sacks which have been saturated with a solution of permanganate of potash. He says "By this means it will retain its freshness for a couple of weeks. The French employed the same method in 1820, in order to preserve it for human food. The papal ban has never reached the ears of the peoples of Asiatic Russia, Tartars, Calmucks, Kirghese, and others, and they still eat it with pleasure. A vast quantity of colt skins come thence to the west to be marketed

"On this account conserved horseflesh should be used to feed the million and a half Russian prisoners in our hands, since they would gladly eat it. In any case it would be better than the frozen Canadian or Argentine meat which is set before our countrymen in English prisons, and whose odor and condition rouse such complaint. In conclusion, Dr Heyking describes a process for making excellent fish food from horseflesh."

The Alleged Allotrophy of Copper

MUCH interest was aroused recently by the announced results of dilatometric experiments by Prof. Ernst Cohen and W D. Hulderman, leading to the conclusion that copper exists in two allotropic forms, having a transition point at 71.7 deg Cent. to 69.2 deg. Cent., under varying conditions of fineness and previous contact with an electrolyte. (See SCIENTIFIC AMERICAN SUPPLEMENT, December 25th, 1915, p. 410.) These observations, if verified, would be of far-reaching industrial as well as scientific importance; hence the matter has been investigated at the U. S. Bureau of Standards by Messrs. Burgess and Kellberg, who used an electric resistance method. The details are published in the *Journal* of the Washington Academy of Sciences. These experiments do not confirm the results announced by Cohen and Helderman, but show that an allotropic transformation of copper at about 70 deg. Cent. does not exist, that the resistance of copper in the range of 0 deg. to 100 deg. Cent. varies continuously, and ordinary copper is most probably not in a metastable state. The authors point out that "it is extremely regrettable that such a far-reaching and disquieting announcement [illegible] temperatures of a metal [illegible] important in exact [illegible] given out on the basis of [illegible] ments."

[illegible]

[illegible] It has been recently [illegible] that the United States Navy Department has placed an order with a prominent American aeroplane manufacturer for six steel hydro-aeroplanes, which are [illegible] for service at the Pensacola Naval Aeronautic Station. The fuselages, pontoon frames and control [illegible] of the hydro-aeroplanes are to be made of steel.

The Efficiency of Parachutes in saving the lives of aeroplane pilots appears to have been proved in the [illegible] demonstration of Colonel Maitland of the Royal Naval Air Service, who jumped from an aeroplane at an altitude of 10,000 feet and landed safely, thanks to the parachute of special design which he used. It required [illegible] minutes for the descent.

New French Anti-Aircraft Gun.—According to *Aéronautics*, it is learned from Allied sources that a new anti-aircraft gun recently adopted by the French armies has given the most satisfactory results. In its general lines, the gun resembles the famous 75 mm. quick-firer; its recoil is rather less than 3 feet and the shell it fires weighs 35 pounds. The projectile is fired at a muzzle velocity of 1,870 feet per second

France a Purveyor of Aircraft and Airmen to Her Allies.—According to a recent statement in *Le Matin*, there is to be a meeting of the Anglo-French aviation corps chiefs once a month at Paris. The meetings will be attended by representatives of the other Allies, in order that unity of direction may obtain in the air service of the Entente nations. Carrying out the plan still further, Russian aviators will be sent to France for instruction and French instructors will go to Russia. Since the beginning of the war, continues the editorial comment, France has furnished her Allies with one fifth of her output of aeroplanes and one third of the motors she has produced

Aircraft Bombs Mentioned in Ordnance Report.—Among the interesting items mentioned in the annual report of Rear Admiral Strauss, chief of the Bureau of Ordnance of the Navy Department, is the manufacture of bombs for use by aircraft. It is stated in the report that these have proved satisfactory in tests and that more will be manufactured Another interesting item is that relating to a one-pounder gun which has been developed by the Bureau for use on aeroplanes. Plans are under way for increasing the calibre of this gun. There is now being manufactured a large number of 3-inch anti-aircraft guns for use on all battleships, while designs have been made for a similar type of 4-inch calibre.

Equipment of German Aircraft—Details regarding a Teuton hydro-aeroplane which fell into the hands of the Russians in the Riga region are of unusual interest in that they disclose the thoroughness with which German aircraft are finished and equipped To quote from the report of the *Morning Post* correspondent at Petrograd "All the necessary manipulating parts of the machinery are made luminous at night with a radium composition. There is a special newly invented level to facilitate handling the 'plane in darkness, and a special compass, and seats are provided for three. The hydro-aeroplane carries a searchlight, a Maxim, and a rifle, with an adequate supply of ammunition, and ten bombs, five on each side, of ten pounds weight apiece."

Huge American-Built Battleplanes for Allies.—It is announced by the officials of an American aeroplane manufacturing company that orders have been placed by the Allied governments for 11 huge battleplanes of most modern design Each aeroplane will weigh in the neighborhood of 30,000 pounds, and the frame work will be entirely of steel. It is said that the wing spread is to be 180 feet, while the length of the aeroplane from tail to propellers will be 104 feet. The framework will be constructed on the cantilever truss principle, insuring great strength with a minimum weight. Twin bodies will be used, each body carrying an engine of 800 horse-power It is planned to arm the machines with four guns, two fore and two aft, of a calibre of between 1½ and 2 inches, and capable of firing 20 to 40 shots per minute. Each airship will carry a number of bombs of any size up to 14 inches in diameter. The specifications call for a speed of 85 miles an hour with full load and a crew of six men.

New Compressed-Air Motor for Model Planes.—Although miniature motors operated by compressed air are not a novelty in the field of model flying machines, still a new type which has just made its appearance is sufficiently different from the others to command passing comment. It is a five-cylinder rotary type and weighs but four ounces with propeller and mounting frame. On 30 pounds pressure the motor will turn over [illegible] r. p. m. The bore of the cylinders is 11/32 [illegible] the stroke 9/16 inch. The "overhand" [illegible] the motor on model aero-[illegible] of the valve springs, the [illegible] frame and tank are made of [illegible]

Science

[illegible] Mitigation forms the subject of an important publication of the U. S. Bureau of Standards, issued as Technologic Paper No. 52. It discusses in detail the various methods of electrolysis mitigation heretofore tried or proposed for protecting underground structures, these being treated under two heads, *viz.*, pipes and the railway return system. Regulatory and legal aspects of the subject are also discussed.

Radio Stations of the United States.—The Bureau of Navigation, Department of Commerce, has recently issued the 1915 edition of "Radio Stations of the United States." This list shows that there are now 5,078 radio stations in the United States, an increase of 1,189 since 1914. They are classified as follows Government and commercial land stations, 224, Government and commercial ship stations, 895, special land stations, 118, general and restricted amateur stations, 3,836.

Rabies.—A case of rabies reported in England last spring was the first in that country since 1902, and occurred in a dog that was being held in the six months' quarantine which the English law imposes on all dogs brought into the country to prevent the introduction of this disease. Rabies was banished from England by muzzling Australia and New Zealand have never had any cases of rabies, and a system of quarantine and inspection prevents its introduction. Sweden, Norway and Denmark are practically free from it.

Coast and Geodetic Survey Publications—We recently called attention to the plan adopted by the U S Geological Survey of displaying and selling copies of the Topographic Atlas sheets at post offices. It is now announced that the Coast and Geodetic Survey will display in the post office of each important seaport in the United States a copy of the principal local coast chart which it publishes, together with information as to how its charts and other publications may be obtained These include sailing charts, general charts of the coast, harbor charts, tide tables, coast pilots, notices to mariners, and miscellaneous scientific publications

Elster and Geitel—A large number of scientific men in Germany and Austria have united in publishing a "Festschrift" in honor of the sixtieth birthdays of Julius Elster and Hans Geitel, which occurred December 24th, 1914, and July 16th, 1915, respectively These two men, one a lecturer and the other a professor of physics and mathematics at the gymnasium in Wolfenbüttel, furnish an almost unique example of collaboration in scientific investigation and writing so intimate that the names of the collaborators are rarely mentioned separately Except in the minds of their personal acquaintances, "Elster and Geitel" constitute a single personality, and a very prominent one, in the realm of the new physics. They have been pioneers in the investigation of radioactivity, ionisation and kindred subjects. The "Festschrift" above mentioned comprises a collection of original memoirs by the numerous contributors.

The Activity of Lassen Peak—the only active volcano in the United States—appears to have reached its culmination on May 21, when violent explosive eruptions occurred and "flames" were said for the first time to have issued from the summit of the peak This eruption caused Hat Creek, a stream on the north side of the mountain, to overflow its banks and sweep down over its entire flood plain a vast sheet of mud and water Adjacent farms were buried in from 1 to 3 feet of mud. Ashes from the explosions were carried eastward more than 200 miles. The outburst is said to have been preceded by an earthquake. Since that date the volcano has subsided, and by the end of September it had nearly ceased its activity A small eruption was observed as late as August 6th, and a pillar of smoke arose from the summit September 9th and 23rd.

An Experimental Study of Pellagra—Drs. Goldberger and Wheeler, of the U S Public Health Service, have just reported the results of a most interesting experimental investigation of pellagra, carried out at the farm of the Mississippi State Penitentiary A volunteer squad of 12 white male convicts from 24 to 50 years of age was organized, and these men submitted themselves to experiment, under the incentive of an offer of pardon from the Governor, together with assurance of proper care and treatment if needed There was no history of the occurrence of pellagra on the farm, and from the beginning of the experiment the squad was strictly segregated and under guard day and night. One man was disqualified in the course of the experiment. The rest remained under observation from the beginning of February to the end of October, 1915 Until April 19th they were kept on the ordinary prison diet, and no evidence of pellagra was detected Thereafter they were kept on a restricted, one-sided, mainly carbohydrate (cereal) diet. Of the 11 volunteers, no less than six developed symptoms, including a "typical" dermatitis, justifying a diagnosis of pellagra. No other person on the farm presented evidence justifying even a suspicion of the disease.

Inventions

Phonograph Records on a Paper Base.—Thomas A. Edison has recently been awarded a patent on a process of making phonograph records of a composition consisting mainly of diphenylamin and shellac, with the addition of some minor ingredients This is said to be not only harder and more durable than the compound now made use of, but also permits of the manufacture of these records on a base of paper, making possible a material reduction in the cost of their production. Mr Edison has also been granted a patent on an improved mounting for a reproducer carrying a stylus instead of a needle. There has been some difficulty heretofore experienced in making the stylus point follow the groove of the record, but this trouble is said to have been overcome by the new form of mounting The stylus used in this case is a polished diamond

Air Method of Measuring Hides—A new German process just patented in this country for measuring the area of hides, makes use of a pneumatic method instead of the mechanical methods which have heretofore been in vogue It is claimed for the pneumatic process that it is quicker and more accurate than anything that has yet been devised A table top mounted on a funnel base has many perforations of equal size placed at regular intervals. A suction fan draws its supply through these holes, and the skin to be measured being placed upon this table, causes a reduction of the air current cross section Thus a rarification of the air with a resultant measurable sub pressure is created which serves for a calculation of the area of the hide which is resting on the perforated plate This figure is indicated by the combined readings of a vacuum gage and the tachometer arranged together at a convenient point over the table

Prevents the Fireman's Death Plunge—A common form of railroad accident is that which often takes place when by some accident to the coupling between them the tender and the locomotive become separated In such cases the air brakes are automatically applied and the runaway train brought to a stop But if the fireman is at his post on the tender, the sudden application of the brakes is sufficient to throw him off his feet and he is hurled headlong under the wheels of his own train which has not yet been brought to a complete standstill Matthew J Slattery and Charles A. Diehm, two railroad men of Philadelphia have been recently awarded a patent on a device which is designed to save the fireman's life in this emergency The apparatus consists of a metal net, carried beneath the floor of the tender, which, in case of a parting between the locomotive and tender, will be released and drawn forward to provide a safety net to catch any one who may be standing on the tender at the time of the accident.

Bird Houses Made of Clay—Harris M Benedict, of Cincinnati Ohio, who has achieved a wide reputation as the result of his endeavors to work up a sentiment in favor of protection for wild birds, has been recently granted a patent on a bird box which has a number of novel and interesting features. In the first place it is of a deep pitcher like shape and made of fire clay which can be readily shaped while in the plastic form The surface may be made to simulate the bark of the tree The bark like finish makes it particularly desirable for the birds, as these feathered visitors are known to avoid anything in the way of a home that is too conspicuous. This bird box has the usual exit and entrance orifice near the top, with a raised waving line inside by which the little birds may help themselves to the entrance when this assistance is required Another novel feature is the sloping lid with an overhang to protect the interior from being flooded by storm, as well as a deep flange to prevent it from being dislodged by the wind By means of this lid the bird lover may watch the progress of his tiny charges

Double-Bladed Hack Saw—The capacity and speed of the power-driven hack saw has been doubled by a saw which has two blades, each one attacking the work from opposite sides thus doubling the capacity of the ordinary single bladed machine It is said to be possible to get 270 strokes per minute with this apparatus. The blades move up and down in unison, one cutting on the down stroke and the other on the up The sawing is thus a continuous operation, both saws feeding into the stock and releasing on the return The device makes use of standard hack saw blades and by reversing them it is possible to secure full service from them The saw frames are of heavy seamless tubing and are operated in the usual manner, but a novel feature is introduced in the method of keeping the work and blades cool without the use of a pump The lower ends of the frames have ball check valves which work up and down in the cooling solution contained in the base of the machine, thus forcing the cooling liquid through the tubing and down on the saws. This system of circulating the cooling liquid appears as efficient as it is simple.

Woman worker engaged in cementing the metal caps and fastening the water reservoirs in place on the otherwise finished tubes

Highly skilled glass blowers at work forming the X-ray bulbs and sealing in place the metal members

Making of X-Ray Tubes in War Time

How the Unparalleled Demand for Tubes Was Met by French Manufacturers

By Jacques Boyer

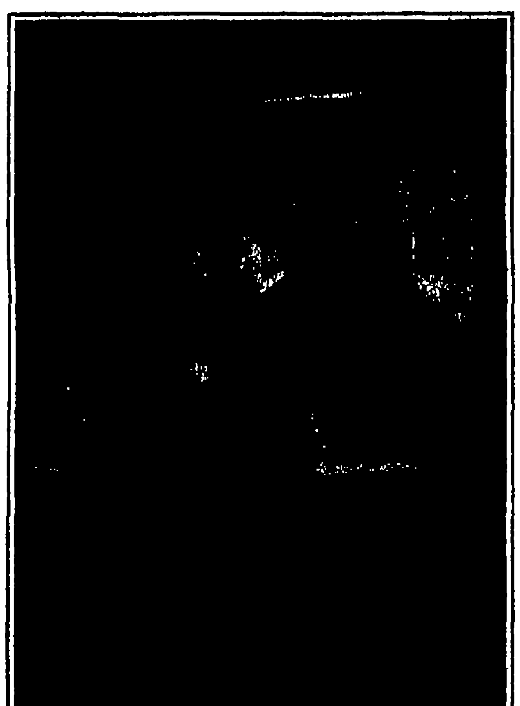
THAT preparedness for war means more than the training and arming of men is now common knowledge, but the extent to which a nation is obliged to meet internal and industrial situations which were not foreseen is difficult to imagine. In the accompanying article, Jacques Boyer tells how France succeeded in meeting the exigencies of what promised to be a most serious situation by making her own X-ray tubes. The story is interesting not only for its scientific value, but also for the lesson in industrial preparedness which it teaches.—EDITOR.

FOR years past France had been equipping the sanitary corps of her army with X ray outfits. She believed this phase of her *matériel* ample in taking care of all her wounded in any war she might engage in. Yet the opening days of the European war found her inadequately provided with X ray plants: the nation was suddenly confronted with the problem of equipping many times the number of her original plants, for the magnitude of the great war exceeded all expectations and preparations. But the problem has since been solved. To-day, France not only supplies all her needs as regards X ray tubes, but she also is supplying those of her allies.

In an X ray equipment the most important member is the tube. Prior to the war there were only two firms engaged in the manufacture of X ray tubes in France, one of these contented itself with the making of small tubes suitable for experiments and school demonstrations, but not for practical work, the other, while in a position to compete with the largest firm in Germany specializing in X ray tubes, concerned itself mostly with other products. In no wise did the two firms possess the facilities for turning out the vast number of tubes suddenly required by the sanitary corps of the French army.

Near the end of August, 1914, the military administration of France, forced to immediate action by the pressing need, requisitioned 400 X ray tubes that happened to form part of the stock of one of the manufacturers at that time. But the tubes seized failed to prove sufficient in the face of the continually increasing number of wounded. It became necessary to restore the French ante-bellum X ray tube factories to their usual activity—at the time they were in a disorganized state owing to the mobilization of the men into the army. The technical personnel was recalled from the front and assigned to the task of not only restoring the X ray tube industry, but also of developing it on a far greater scale than ever before.

Meanwhile the Appert brothers of Clichy, aided by M. Matignon, professor at the Collège de France, and M. H. Pilon succeeded in providing the high grade glass which German glass blowers for years had been importing from France in the crude state and claiming as their own product in the finished glassware. Before the middle of November, 1914, the glass makers were in a position to furnish the raw materials required by the tube manufacturers. There then followed the rapid upbuilding of the revived and greatly enlarged industry.



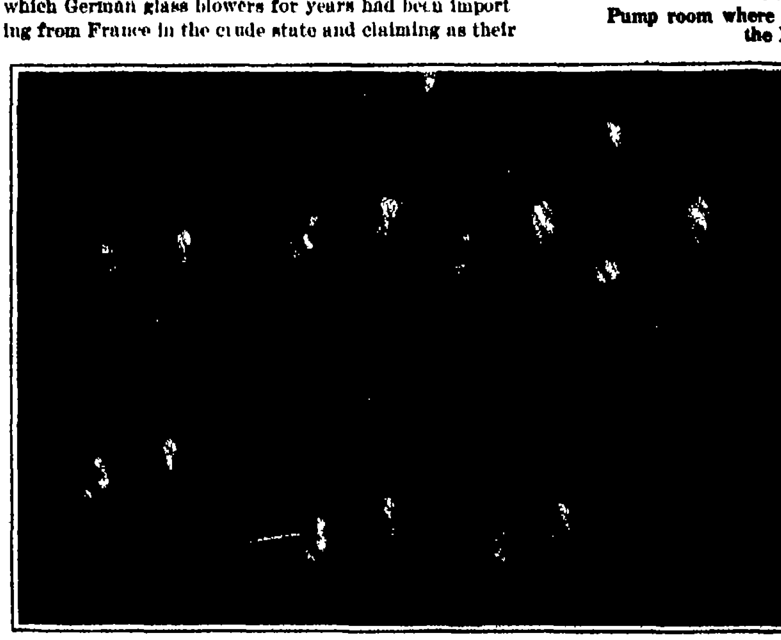
Pump room where the air is exhausted from the X-ray bulbs

The manufacturing of X ray tubes calls for a high degree of skill on the part of the workers. There are numerous steps in the work before the complete tube results, and each tube is subjected to a great number of tests at different stages in its construction as well as upon its completion, so as to ensure perfect results to the ultimate user. There follows a brief description of the manufacture of these tubes in one of the French factories.

For the sake of convenience, the making of the metallic members is considered first. The cathode, which is made of pure aluminum, is machined in the form of a concave mirror, and facing it in the finished tube are the anode and anti-cathode. In many of the French tubes tungsten has been adopted for the reflector, which forms part of the anti-cathode, because of its high melting point. As the copper portion of the latter member heats at the same time as the tungsten reflector, it is provided with heat radiators and a water reservoir for cooling purposes. The anti-cathode is made by cutting a copper bar of the desired diameter into pieces of suitable length. These are machined so that the tungsten reflector can be placed in the center of one end, after which the entire piece is heat-treated in a gas furnace and subsequently subjected to compression in a powerful hydraulic press. As a result of the compression, the two metals are closely joined together and the copper becomes more homogeneous. It should here be stated that the tungsten reflector is carefully adjusted and subsequently soldered after the heat treatment and before the compression. The anti-cathode is then turned in a lathe to the desired diameter and drilled longitudinally, so that it can receive later the tube which serves to connect it with the water reservoir. On the shoulder of the piece there is soldered a collar of platinum, which permits that member to be united ultimately with the glass in the sealing in process.

The next step is the mounting of the anti-cathode on

(*Concluded on page* 110)



Glass bulbs for different types of X-ray tubes at various stages in their blowing and in the sealing-in of electrodes

X-ray tubes representing past and present practice; center, an earlier type tube; right, Coolidge-Pilon 1915 type; left, Pilon O. M. type

Simple Food Tests

Experiments by Which Adulterants May be Detected

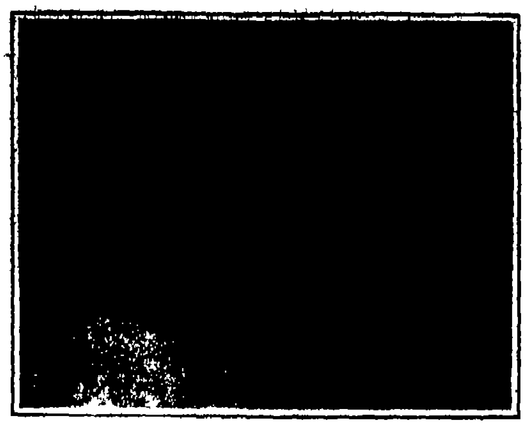
By S. Leonard Bastin

A VERY good test by means of which the best fresh butter may be distinguished from the made-up article or margarine is that in which a small quantity of the sample is placed in a tiny tube. This is set in water sufficiently warm to melt the contents; the sample is kept in a melted state for half an hour and it is then examined. If the butter is pure, and of the highest quality, it will almost certainly be clear. On the other hand with margarine or a worked-up butter a certain cloudiness will be apparent. A more simple, but equally reliable test, is that in which a piece of the suspected article about the size of the tip of the little finger is placed in a spoon. This is held over a gas burner, and the behavior of the sample is watched. Real butter boils quietly, producing a quantity of small bubbles, on the other hand margarine, or a process butter, will crackle and sputter much in the way that green leaves do when they are placed on a fire.

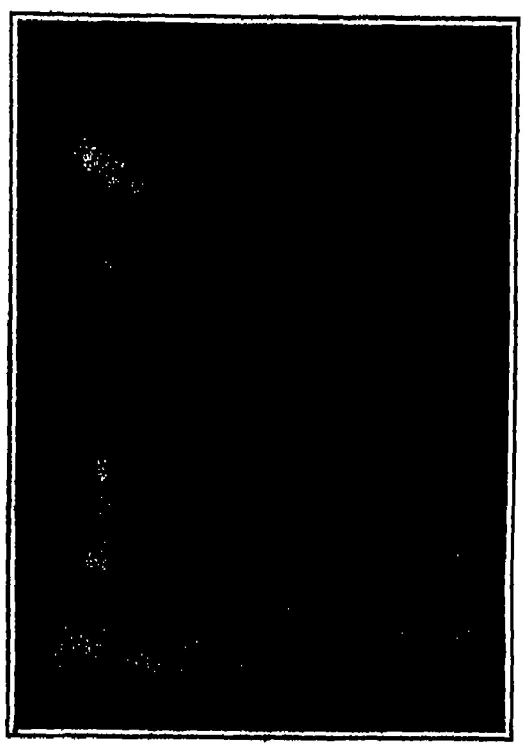
Two simple tests for tea and sugar are indicated. One of the commonest adulterations of tea is the dyeing of the leaves to make them look a good color. The fraud is very easy to detect. Get a clean white cloth and rub some of the dry leaves between the material. Pure tea which has not been treated should leave no mark on the cloth, dyed tea will make a very definite stain that will not easily be rubbed away.

Several additions are now and again made to sugar and, without an elaborate analysis, it is not easy to determine the exact nature of these. As a rule pure sugar should answer the following test satisfactorily. Make an almost saturated solution of sugar and water, place this in a glass tube, then stand in front of some print. It should be possible to read the type quite clearly through the sugar solution. In the case of brown or raw sugars there might be a certain amount of discoloration of the water, though any turbidness is almost certainly an indication of adulteration.

An unscrupulous baker will work into his bread as much salt as possible. Experts say that an increasingly large amount of salt may be put into bread without the consumer's being aware of it. The idea is that bread loaded with salt weighs more heavily on account of the moisture which it will retain. To find out the real value of bread from the standpoint of weight a little experiment may be followed. Take two samples of equal weight, and bake these in an oven for an hour. At the end of this time weigh again. That which is the heavier is the better value. The addition of alum to bread to make it white (often used to mask an inferior flour) is much to be condemned. Small quantities of alum taken regularly in this way are very harmful. Happily a simple test for the discovery of alum in bread is available. Take a sample of the suspected article and place it in a saucer. Then pour over it a solution of carbonate of ammonia. If alum is present in the bread it will turn black, but if the bread is pure no change will take place.



Pure sugar when dissolved in water should be so transparent that ordinary newspaper print can be read through it



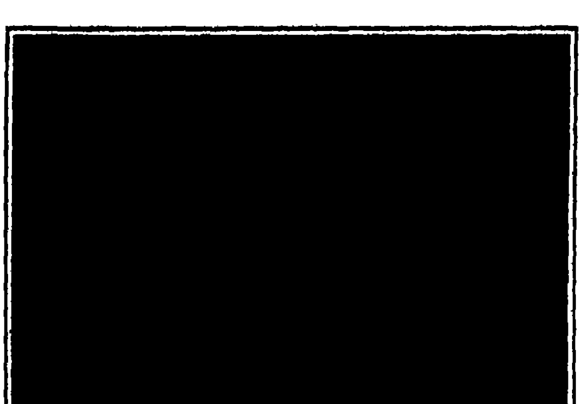
Dry tea leaves rubbed in a white cloth, will leave a stain if the tea has been "doctored;" if not, the cloth will show no color

A large amount of jam is dyed, brightly colored articles should always be suspected. The point may be definitely established in this way. Mix a sample of the jam or jelly with an equal quantity of water. Throw into the mixture a piece of cotton wool and boil for half an hour. Now try to wash out the stain. If the jam is pure the stain can be easily removed; where dye has been used no amount of washing will get rid of the stain.

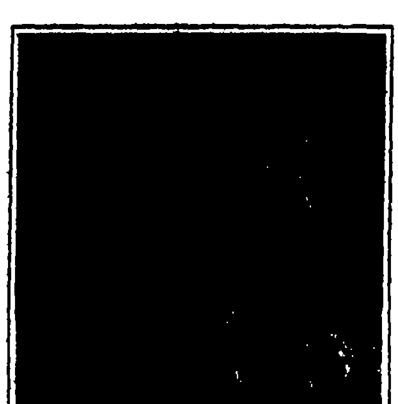
Finally a good test for vinegar may be described. In this case a common adulteration is the addition of some mineral acid. The presence of the harmful article is readily disclosed. Take a sample of the vinegar and add a few drops of methyl aniline violet. Pure vinegar shows no alteration, but the adulterated sample turns a blue or a green color.

The Current Supplement

THE article on *The Improvement of High Boiling Petroleum Oils by the Action of Aluminum Chloride* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, for January 21st, is of considerable technical value in view of the increasing price of gasoline. It contains tables of tests of a number of oils from different sources. *The Waterpowers of Canada* summarizes the facts relating to a number of power possibilities some of which are under development, and there are a number of excellent illustrations. An interesting diagrammatical sketch illustrates *Trenching and Mining Operations*, as carried on at the battle front in France. *How Trees Heal Their Wounds* describes the provisions made by nature for self healing of injuries, a subject suggested by the spectacle of trees in the war regions of Europe that have suffered from shell and machine gun fire. *Leather Investigations* gives many facts relating to the manufacture of shoe leather that are of importance to everyone. *Bacteriology of Wounds in War* treats of a subject of extreme importance, and of the complicated conditions of the special case. There is another article on *Metastability of Metals*, supplementing one recently published. *The Largest Gasoline Ferryboat* describes and illustrates a craft unique in many ways that is successfully operated by ordinary gasoline instead of a heavy oil, as is the usual practice in vessels of large size. *Washing Locomotive Smoke* tells how the nuisance created by a railroad engine house in a populous district was abated. *The Control and Protecting of Electric Systems* is an interesting story of the marvelous growth in the development of electric power, and some of the problems that accompanied it. The merits of *Cast Iron as a Material for Explosive Shells* is discussed in a short article. *Tortoise Shell Divination* is another of the shorter articles of interest.



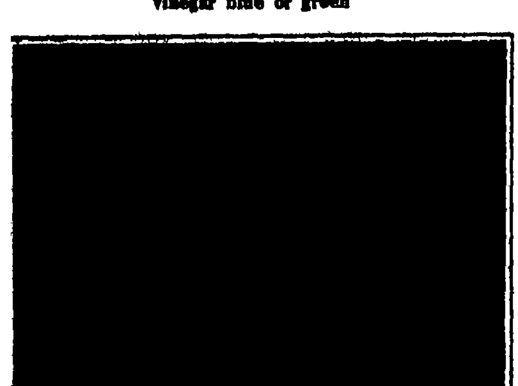
Pure butter boils quietly, artificial butter or margarine sputters and crackles



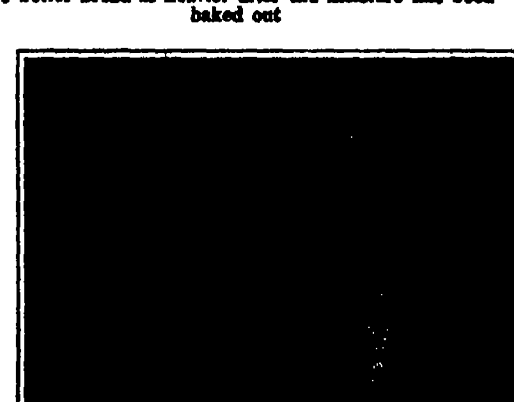
Methyl aniline violet turns adulterated vinegar blue or green

The better bread is heavier after the moisture has been baked out

Dyed jam will make a stain in cotton that will not wash out after the cotton has been boiled



Bread containing alum will turn black when treated with carbonate of ammonia



Pure melted butter is transparent, artificial butter is cloudy

Strategic Moves of the War, January 13th, 1916

By Our Military Expert

ASIDE from the strong German attack which occurred in the Champaign sector during the second week of January, and which was thrust back by the French counter movement, attention still centers upon Bukowina and the Czernowitz district, where the Russian offensive continues its efforts to oust the Teutonic right from its position

Considerable interest attaches to the Mesopotamia campaign, which although not of the character of major operations has a considerable political bearing upon the Balkan situation and that of India

The western line seems immovable as ever during the past months, the eastern line, from Riga to the Pripet marshes remains inactive, the first Serbian campaign has been brought to a close by the clearing of the district, while the Entente allies are gathering strength at Saloniki behind lines which are reported as steadily becoming approximately impregnable The situation at the Grecian city powerfully suggests the lines of Torres Vedras behind which Wellington prepared for a drive in the Peninsula campaign—which eventually resulted in a Waterloo a few years later

The *map showing the left of the Russian line may* well be of interest as it shows clearly the probable objective of the Russian offensive

Czernowitz is merely an incident in the campaign, which must be overcome before it can be prosecuted to a measure of success. A direct drive upon this city is hardly needed to secure its possession, a cutting of the railway line to Kolomea, which is threatened by the bend of Russ force in its vicinity, would almost immediately necessitate the evacuation of Czernowitz, and such an attempt may well be expected

The object of the drive must be the Halicz Stanislau Kolomea line, three railway centers of importance, the connecting territory of which lies almost entirely south of the Dniester According to the latest reports, the Russian position is nowhere more than 30 English miles distant from this important line. These three towns are all Teutonic bases at the present time, the information that the Czernowitz base has been shifted to Kolomea is doubtless true, as a glance at the Russian position which threatens the railway will show Possession of Stanislau by the Russians would at once sever the lateral communications so important to extensive operations and the shuttling of forces from point to point. It is, therefore, the most important objective of the line.

It is rather evident, upon analysis of dispatches from other Teutonic fields of action, that all available Austrian troops have been shifted to this locality with the exception of those engaged in Montenegro, and the character of the country lends itself so well to defensive operations, that it is highly problematical whether *even rejuvenated Russia can successfully force through,* even at a tremendous cost in life The greatest possibility of success lies in activity on another front which may necessitate the holding of reinforcing troops or require a weakening of the Bukowina line—which is rather improbable—to meet.

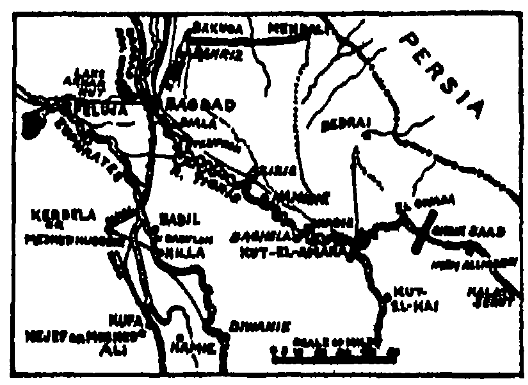
The destination of the forces withdrawn from Gallipoli enters into the question. There are several points to which these troops, estimated at some 200,000 strong, may be sent, namely, the western line, where a stupendous attempt to break the German line would insist upon the recall of Teuton forces elsewhere, to Mesopotamia, that a probability of prompt control of the section would be engendered, to the defense of the Suez Canal section, which reports from Teutonia say is to be attacked in force, or to Saloniki, in prepara*tion for an offensive return through the Balkans.*

The lot of the prognosticator is an unenviable one, yet the rôle must be assumed at times, under protection of the law of probabilities From the newly awakened Russian activity, then, it seems probable that at least a good portion of Entente strength from Gallipoli will find its way to Saloniki, as action from this point would more nearly supplement Russia's efforts than from anywhere else

From where the Russian line touches the border of Roumania, it extends westward by north, practically paralleling the railway from Nowoselica to Lusan, although whether it is 5 miles away or 15 it is impossible to say, from the meager exactness of dispatches. It is sufficiently close, however, to establish a very real threat to not only Czernowitz but its communications From this point the line bends northward, striking the Stripa near its junction with the Dniester Reports state that the Stripa is held by the Russians from Buczacz to the vicinity of Zloczow, to the northwest of Tarnopol Beyond this point, the line sags westward in the direction of Toporow on the Styr, following the line of this river to the eastward, around Lutzk, where it again springs forward to the river to the northward.

It is impossible to exactly locate the line, for ample information is not vouchsafed by the Russian censorship, and for such a general article as this, the approximate position with relation to important junctions and rivers is sufficient for the understanding of the general situation. In any event, future developments will be rather dependent upon operations elsewhere in Europe

The operations in Mesopotamia date from the early part of April At that time a mixed British army corps in which were many Indian troops undertook protection of the great oil wells near the head of the Persian Gulf Columns were then dispatched up the Euphrates and the Tigris, moving upon Baghdad. Late in November the forces arrived within striking distance of Baghdad, after having fought a hard fight against the Turks and local conditions Water was scarce and as the city was



British operations on the Tigris

The Russian offensive in Galicia

neared, the Turkish forces became too numerous for the slender column to successfully cope with and retirement became necessary

During the retreat, a force numbering about 10,000 was detached at Kut El Amara at the junction of the Tigris and the Shat, and left to hold the place while the main forces continued their retreat.

During December, the Turks, rejoicing in the defeat of the British column gathered in considerable strength in the vicinity of Kut El Amara and succeeded in surrounding the detachment.

A British force left Imam Alligarbi early in January to attempt relief of the Kut position, marching by the south bank of the Tigris. At Sheik Saad the Turkish forces were encountered and those on the north bank were pushed back with comparative ease, while the main British column engaged to the southward, where, it is reported, the Turkish forces were compelled to retire, being pursued by the British.

This British Mesopotamia campaign has been the subject of much adverse criticism abroad. In the first place, claim is made that the force sent into the movement was inadequate to accomplish the desired results and that, even if it had been possible for the expedition to cut its way through to Baghdad, sufficient strength would not have been available for effective control of the section. It is, therefore, not at all improbable that a portion of the troops released by the withdrawal from Gallipoli will soon be actively engaged in Mesopotamia.

It is scarcely to be expected that much of the Turkish force released from the Dardanelles will be sent into Mesopotamia, as it is believed that ample Teutonic forces are already in the section to offset whatever Entente troops may be present. It is, however, not entirely unreasonable to suppose that at least a demonstration may be made against Egypt, as has been predicted by the Teuton press for many weeks, if for no other purpose than that of holding the newly faced Entente troops close to their present location.

Main interest will probably continue to lie with the Russian front. Not only is a general retirement of German advance base reported on the south of the line, but from the north as well, although there now appears no very real threat of menace on the Riga sector. How far the present offensive movement in the south will be extended throughout the line is hard to say. To adequately man a line requires something like 7,000 men per mile of front, on a battle line 800 miles in length—the approximate contact length of the existing eastern line—5,600,000 men should be necessary But for purposes of offensive movement, this strength must be at least trebled locally, that casualties may be easily replaced, momentum secured for the advance and sufficient troops be left after the climax of assault to hold the position.

The front of Russian activity in the south is about 250 miles in length—say 200 miles for that part actually supposed to be under advance. If the proportion of available men for attack is but 14,000 per mile, almost 3,000,000 men are necessary for an adequate movement, and it is seriously to be doubted whether such a number is engaged on the Russian side If they are there, they have almost certainly been taken from another part of the line

The Germans have a way most disconcerting to their enemies, of breaking out in fresh places. The Teutonic intelligence service is more complete than that of any other country and, it is reported, finds its greatest amplification in Russia. It is then highly improbable that Germany does not know definitely where these troops have been taken from

Basing the conclusion upon past performances, it is believed that a strong Teutonic offensive is about due for launching somewhere north of Pripet. The section between the Niemen and Vilna seems to offer an enticing ground, for the divergent railways from Grodno as a base, *form two radiants of supply* and the main line of the railway which furnishes the lateral communications for the Russian front constitutes a prize well worth striving to secure.

It need occasion no surprise, then, if this section becomes the scene of great activity in the near future, unless the Entente allies strike beforehand in some now unknown quarter

Eating Raw Food

COMMENTING on the recent "raw food" school, Dr Toulouse, a French physician, points out some of the advantages and drawbacks of the idea of consuming all food raw Naturally in our common practice this is often done and even in the case of animal flesh such as oysters, dried beef, and others, such substances are well digested, even better, it is claimed, than cooked meat. Salads, radishes and all fruits are eaten raw, and while they cause more work to the digestive organs by the character of the cellulose under such conditions, on the other hand they afford ferments which greatly aid in digestion. Comparing the two systems, cooked or raw, the latter is the most essential for preserving life, for when the system is deprived of all fresh food, diseases of the scorbutic type appear, especially in children. The only drawback with raw food is that it may bring disease germs, which cooking destroys, and this consideration above recommends cooking in numerous cases. However an important point is that certain aliments are quite indigestible, even though the most nutritious, *i. e.*, dried vegetables such as beans and peas; and even the most convinced of the new vegetarian school could not consume these. In the foregoing the question of taste was not considered, but in fact, cooking develops a flavor which aids in the secretion of digestive substances, and hence it is not a simple question of enjoyment of food. The practice of eating raw food does not therefore appear to be justified beyond the point where it is already the customary practice.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Our Future Naval Policy

To the Editor of the SCIENTIFIC AMERICAN:

After 18 months of the greatest war in history, Great Britain has shown by her navy that sea supremacy is absolutely vital for a successful carrying on of a gigantic campaign—she has also shown that by secret treaties she undertook to keep the seas open while other strong military nations provided the fighting forces. It is almost unbelievable that after all the lessons that we have learned in the past few months that no definite steps have been taken to immediately commence and make good the weak places in our Navy. It must be borne in mind that the United States of America is really in a more perilous position than England. We have an immense sea coast connected by a canal that in time of war would be in danger of destruction at a vital point, which would at once divide our Navy. Seeing that we do not wish to make any alliances with Europe or Asia we must always make the allowance of being attacked by a combination of powers. I see it advocated that by 1925 our Navy should be as strong as any two powers except England. Now if England in all her shipbuilding policies had made the same rule she would be in a different position to-day. For instance, if England had said, we will always have as strong a navy as France and Japan, and not count Germany, where would she be to-day? Seeing how treaties are almost worthless when the actual trouble is imminent, does it not behoove us to have a navy equal to England's. Does the average man know how many miles of sea coast we have, to say nothing of our distant possessions, of a possible hostile continent to the north and another one to the south only waiting to fly at our throats when the proper time arrives? We must look at it from the point of view of a nation, absolutely alone, with no defensive alliances, and liable to attack on both coasts. There seems to be some attempt to make an alliance with the South American Republics. Again let us look at the geography. The strongest countries, namely, Argentine, Brazil and Chili, are the farthest away. None of these countries has a very large navy and in case we were attacked by any European combination the South Americans would probably decide that the place for their own navies was at home—also at present none of these Republics are in a financial position to start out on a big navy program. So it just remains for ourselves to take note of the lessons that are being learned in the present conflict and if possible see to it, and correct some of the mistakes and not be found short when the time comes. Why cannot the people put full faith and confidence in the Navy Board and immediately vote the money without a quibble or dissenting vote and start now at once to put our navy where it should be? I remember several years ago making a trip down the River Clyde from Glasgow to the sea, and both sides of that little crooked river were simply lined with shipbuilding yards capable of building anything from the "Lusitania" to a "dreadnought." These were all private yards and in almost every yard there was a warship of some kind in course of construction and I distinctly remember at one yard in Greenock two large battleships on the slips, one cruiser being finished fitting out and three 10,000-ton passenger steamers for South American trade—and all this is only one instance of private enterprise with government help. Now at the present time we are in a better position to build a navy than ever before in the history of the country. All our shipyards are working overtime on orders for cargo ships and all the machine shops connected with the yards are in good shape. So why cannot these same yards be encouraged to bid on navy work with a prospect of continued orders instead of the yards drifting back to their old pre-war stage? It must be remembered that when the war is over there will be a feverish activity in European countries for the building of all classes of shipping, both mercantile and naval, and we shall have to meet this combination. To show what a low ebb our mercantile marine had reached before the war: Our only transatlantic line from New York to Europe had no longer catered for first-class passengers. Now that shippers and the people in general see our weakness in the scarcity of American cargo steamers, could not something be done at once by Congress to vote a subsidy for every ton of export carried in American bottoms? If something is not done right off to protect this ship industry we shall never be able to meet the cut-throat competition that is coming. Does the average man know the history of American shipping on the Pacific Coast? If not, it ought to be brought out in bulletin form and given to every voter in the country. What is the percentage of American seamen on American ships running out of our ports? It is ridiculously small; The engine room and deck officers being Americans, the stokers and deckhands are made up of all nationalities. Now Germany and Great Britain have their large passenger and cargo steamers in every corner of the globe and almost all the officers and in many cases the engine-room staff are naval reserve men, who in time of war are capable of being transferred immediately on to transports, home defense ships, mine sweepers, etc. Where are we in time of war going to get the trained men to replace the lives lost in the sinking of, suppose, two dreadnoughts? The making of a naval seaman is becoming more and more of a problem every year, and once having picked out the most intelligent and useful men and trained them, why not have them in naval reserve? A few months ago the old revenue cutter "Woodbury" was sold out of the navy for a song and destroyed. Now how much more useful she could have been lying anchored in any coast seaport as a training school ship for boys. Every State has its reformatory schools. Why not have the Government loan one of those old ships to each section having a port and use them for training and fitting these boys for a seafaring life? We have plenty of farmers, but it takes years to make a good sailor and we have in the majority of these boys the foundation of an excellent lot of sailors and by the time they are 18 to 20 years of age they would be invaluable as sea men on both the naval and mercantile ships of the country. I would also advocate a very vigorous advertising policy to reach the rural districts where as a rule, a very large number of the best young men are drifting to towns at an age when they would be most easily trained and would make good, rugged sailors. There is no sailor in the world better paid and better fed than the American sailor, and the chances of advancement are very good to anyone who puts his best into the life and pushes ahead. Why not have a special corps of moving picture films to tour all the smallest towns and give a free show of life in the navy—and have the advantages, the pay, and the inducements offered by the navy posted in every post office in the Union, instead of in only the principal post offices of the State, and also have a working agreement between the recruiting officers of the navy and the heads of our own steamship lines, so that in case a man is not eligible for the navy on account of some very small defect he could be found a position in the mercantile marine? By the man's actions of attempting to join the navy is shown that he desires a seafaring life, so why lose track of him altogether when he is still fit for the upbuilding of our merchant fleet? I have seen it quoted that we have at present all the naval sailors necessary, but if our shipbuilding program is carried out we want to start at once on a policy of making the naval and mercantile marine known to all our young men as a patriotic, healthy, and prosperous life. Every year we see thousands of our young men going through high schools and graduating. What has been done to interest them, the most inteligent in the country, to adopt the sea as a profession and once more get the Stars and Stripes seen in every sea?

Sebago Lake, Maine — PATRIOTIC

How a Rifle Is Sighted

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of Dec. 11th there is an article headed "How a Rifle is Sighted" which, while very accurately describing the sights on the various military rifles gives such a curious description as to how one sights a rifle, in aiming that I feel I must answer it.

The writer of this article says "Normally the shooter sees the rear sight sharply for an instant, as he draws the front sight into the notch, then, trying to hold the front sight into the notch, then trying to hold the front sight in its correct position, he focuses on the mark. By that time the rear sight is very blurry and fuzzy, because the eye is not in focus for something 15 inches away, but for the infinity of distance."

Now I have shot all my life, and often I have to shoot to save my skin, when shooting dangerous game, and I have never had the things happen to me described above.

The rear sight never "appears blurry or fuzzy" to me, nor do I "see the rear sight sharply for an instant" and then try to do the same on the front sight, nor do I hunt for the object I want to hit by moving the front sight about.

What I do, and I think all big game shooters will agree with me, is to entirely ignore the hind sight. I look at the spot on the object I want to hit, (or, if it is moving, at an imaginary spot the right distance in front of it), bring up the rifle and as it touches my shoulder, the front sight is on the spot I want it, the front sight is just right in the middle of the notch of the rear sight and the rifle goes off.

The whole of this process takes place instantly and mechanically. I have my aiming eye focussed on the object I want to hit all the time. I never try to get a clear view of the hind sight, any more than a man with a shot gun does. I look at the object and the rifle comes up aimed correctly.

I remember when typewriters first were introduced the same idea of not being able to focus the eyes rapidly in searching for each letter and then striking it, was thought to be very bad for the eyes, but a writer on the machine can shut his eyes and type with accuracy.

The moment a man begins to hunt for his sights he is no use for practical shooting at rapidly moving objects, although he may be able to hit a stationary target when he has unlimited time to focus his eyes on various objects and then begin to hunt about with the end of his rifle, and then think about squeezing the trigger.

I find the peep sight no use in the dusk of the evening or early dawn, when most of one's shots are taken, also in a thick wood the peep sight is useless.

For extreme accuracy, where there is time to take a stationary aim, the telescope is far in advance of any peep sight, but the open sights are the only practical ones for game shooting and in consequence, I should imagine, for military purposes when the object is moving.

WALTER WINANS,
Olympic Games of 1908 Champion Hunting Rifle Shot.
London, England.

Submarines vs Battleships

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Roger L. Gordon in a letter to you published Jan. 8th in your correspondence column states about submarines: "They are worthless, practically, for defense. If the enemy, through the weakness of our battle fleet, secures control of the sea, he will, as at the Dardanelles, take measures to neutralize them."

The Allies believed there were no submarines at the Dardanelles and quoting from their own words, "They hoped to do something before the pests arrived." One of the pests arrived and accounted for two battle ships. There are many of the pests near the Dardanelles now and the Dardanelles campaign is a failure.

Why have not the English dreadnoughts entered the Baltic? Because they feared the German submarine.

In my opinion the submarine is ideal for defense. Now for the offensive.

The English submarine has entered the Baltic, where the dreadnought dared not go. Much damage was done there by the English submarines.

The French and English submarines have entered the Sea of Marmora where the dreadnoughts could not go.

Except in the Baltic no German or Austrian ship has been 50 miles from a friendly port except the submarines.

I believe no dreadnought of the present design can operate near a hostile port, if that port has submarines.

The Allies control the sea. One reason for that is that they have two or three times as many battle ships as the Central Powers. But the chief reason is that they have ports all over the world and the comparatively few ports of the Central Powers are shut in. Ships from those ports can not get to the open sea without passing the ports of the Allies.

I congratulate the Administration in casting off the cobwebs and asking for 85 coast defense and 15 fleet submarines.

F. A. de PEYSTER.

New York.

Tide Power

To the Editor of the SCIENTIFIC AMERICAN:

In the article entitled Future Possibilities of Electricity (Dec. 4, page 490) the author writing of the inherent difficulties of utilizing the energy of the rotation of the earth refers to the energy of the tides as largely moon power.'

The slip is one of no great importance in the article but it involves a point on which many of your readers may be a little hazy.

If the earth rotated in a longer time than it takes the moon to revolve around it, the friction of the water on itself and the interference of land masses would retard the tides behind the moon. Then the pull of the tides on the moon would retard the moon and accelerate the rotation of the earth. As the earth rotates more rapidly than the moon revolves around it the tides are carried ahead of the moon and their pull on the moon tends to accelerate its motion at the same time it retards the rotation of the earth. A development of power from the incoming tide might lessen these effects by lessening the height to which the tide would otherwise rise, but any development of energy from the outflowing tide would decrease its reaction upon the earth by which it returns some of the energy of the rotation of the earth it had absorbed during flood tide and it would prolong and increase the effect of the forward pull of the tides on the moon. Stated mathematically the attraction of the tides on the moon may be divided into two components, one toward the center of the earth and the other tangential to the moon's orbit. The tangential component carries the moon even a little farther from the earth and increases its potential energy at the expense of the energy of rotation of the earth.

Ceres, California. — M. E. TAYLOR.

The operation of lopping the branches from the felled tree and cutting the bole into logs. Sweden

Packing the twigs and needles into bags in the forest, ready to haul to the distillery Sweden

The Pine Needle Oil Industry

How the Thrifty Europeans Utilize a Waste Product of the Lumbering Industries

By Samuel J. Record

The distillation of the needles, cones and twigs of pines, spruces, cedars, firs, and other conifers is an old established industry in Europe In America, however, the industry has been of a sporadic and uncertain character and it is doubtful if a single commercial plant is now in operation.

The amount of pine needle oil used annually in this country is not known. The importation of the principal firm handling this product is about 12,000 pounds a year The selling price last November, 1915, was 85 cents per pound—EDITOR.

IN Sweden the manufacture of pine needle oil, extract, and other products from *Pinus sylvestris* L. is an industry of considerable importance The largest plant which is located at Jönköping is the outgrowth of a very small beginning made by an apothecary 80 years ago Since 1907 it has been operated by a limited liability company under the style of "Antiebolaget Apotekare Alfr Carlssons Enkas Tallbarrsoljefabrik" The accompanying illustrations of the industry in Sweden were furnished by this company

The raw material is a by product of the lumbering industry and gives employment to farmers, peasants and poor people in the district where the factory is located After the trees are felled and trimmed, women and children collect the branches, with a long curved knife they cut off the twigs with their leaf clusters and small cones and pack them into large burlap bags. These are then loaded on wagons and hauled to the factory

In the plant is a large chopping machine which cuts the leaves and twigs into very fine pieces to make distillation rapid. The stills are large wooden retorts with a capacity of several thousand kilograms of the raw material Steam is passed through the mass and with the liberated volatile oil is condensed and later refined This product, known as Swedish Pine Oil or officially as Aetheroleum Pini sylvestris is a thin, clear fluid, colorless or with a slight greenish tinge giving off the peculiar aroma of Scotch pine needles. It is bottled and sold for use in baths, as a deodorant in hospitals and sickrooms, and for various medicinal purposes.

The non volatile extract that remains in the still is drawn off and refined into pine needle extract (*Extractum Pini sylvestris*) This extract is used solely for baths The spent needles are dumped out in the open and after air-drying are used for fuel in the plant

The Thuringen Mountains of southern Germany have long been an important source of pine needle oil (Fichtennadelöl or Kiefernadelöl), extract and similar products. The needles and twigs of the various kinds of pine trees, especially the mountain pine (*Pinus pumilio* Haenke) are used for this purpose They are collected the latter part of May or early in June cut into small pieces and distilled

For small operations an ordinary pharmaceutical still is sufficient but for larger plants special apparatus is employed. The latter consists of a cylinder with a false bottom, which allows the steam to pass upward through the mass of needles and out into the condenser The false bottom is usually made of zinc and is perforated, the central part rising in the form of a cone or funnel to facilitate the steaming of the mass The distillate flows into a jar and most of the oil rises to the surface and is skimmed off from time to time Some of it, however, remains in the water which is usually subjected to a rectifying process or to an application of salts to prevent waste.

Loading the bags of pine twigs and needles on wagons, before hauling them to the factory Sweden

Unloading still for use in the distillation of pine needles. United States Forest Service Experimental Plant

During the process of distillation some of the steam condenses in the cylinder and flows down through the perforated bottom carrying with it various resinous, albuminous, and tannated substances. This liquid is drawn off and evaporated in a vacuum apparatus until the desired consistency is reached. This product is known as pine-needle extract, but it is necessary to mix pine-needle oil with it to give it the proper perfume.

The mass left in the cylinder is taken out, dried, and shredded, and then perfumed with pine-needle oil and used for pillow and mattress stuffing. It is reputed to be healthful and vermin proof.

The needles and branches of the mountain pine are also distilled on a large scale in the Austrian Alps and the oil obtained from them is extensively used in soap making and other purposes of perfumery

In Switzerland and Tyrol the oil of the silver spruce (*Abies pectinata* D C) is extracted In a pure state it has a very agreeable odor and is, therefore, largely used as a perfume The young cones of the same tree are distilled in Switzerland and Thuringia and the oil appears on the market as pine needle oil It has a milder odor and lower specific gravity than the oil prepared from the needles. The oil of the common spruce (*Picea excelsa* Lk.) is produced in various places in Europe Spruce oil is extensively used for perfuming various compounds, especially shoe polishes.

The use of so many different kinds of conifers to produce leaf oils, and the tendency to group them under common names have lead to considerable confusion in nomenclature so that in many cases the botanical origin cannot be traced with certainty even from the latin labels.

A more serious matter, however, and one which has done much to retard the development of the industry is the debasing of pine needle products with oil of turpentine Regarding this point, Prof Carl Th. Mörner, a Swedish authority on the subject, says (Svensk Farmaceutisk Tidskrift, 1913) "The conditions prevailing can be denoted as far from satisfactory Laying aside the question according to which technique the large quantity of oil of *turpentine* has been added (direct admixture or the use of oil *of* turpentine as 'menstruum', the use of improper crude material, *i. e.*, large branches, etc.), one finds that in too many cases the circumstances point towards a too large quantity of turpentine and in connection herewith a too small quantity of the respective oils specific, more valuable constituent parts, in other words, towards inferior products. In many cases the abnormal *quantity of* oil *of turpentine, or other foreign* oil *or* both, is at the same time so dominating that the products can not justly claim the name given the same but must be designated as adulterated. (This is true in spite of the fact that the trade marks include such epithets as 'bestes,' 'extrafein,' 'schönes,' and others.) Of 28 products analyzed here only 15 can be characterised as perfectly good.

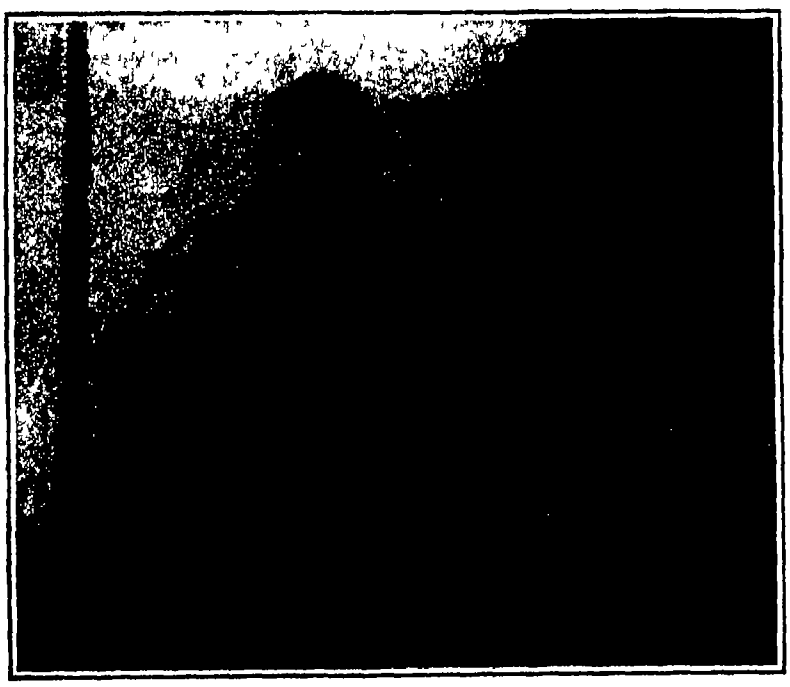
"The manufacture and sale of pine-needle oil seem to

to [illegible] preventing speculation of a similar nature to a very large degree."

Although, as previously stated, the industry has met with indifferent success in America, it is possible that it may be revived on a more substantial basis. The U. S. Forest Service has been conducting a series of investigations to determine the yield and composition of the leaf oils of the more important conifers with a view to utilizing what is not only a waste product of logging operations, but a fire menace as well. In order to prevent forest fires

Cutting machine for chopping pine needles and twigs into pieces for the retorts Carlssons Enka, Jonköping, Sweden

it is usually necessary to dispose of the slash in some way, either by burning or by "lopping" and scattering the limbs so that they will lie close to the ground and rot quickly This work is at present a dead expense which in some instances at least might be turned to profit by distillation of the twigs and needles



Cutting pine needles and twigs in a feed chopper, for use in United States Forest Service experimental still

To obtain specimens of the oils a small distilling apparatus was constructed that had a capacity of from 350 to 400 pounds of chopped needles. The device consisted of a copper heating vessel surmounted by a detachable copper container in which the chopped needles were packed The bottom of the container was fitted with a brass wire screen through which the steam from the boiling water below made its way into the charge A removable cover was connected with the condenser—a copper coil in a galvanized tank through which cold water was flowing The distillate was collected in a large bottle from which the water was drawn off from time to time and returned to the heater

The twigs and needles were run through a feed cutter and chopped into lengths of from one half to one inch. No twigs more than one half inch in diameter were included. In some instances the needles alone were used, but this selection of material was not considered justified by the small difference in results. Although the oil from the leaves consists of aromatic compounds, while the oil from the twigs is of aliphatic derivatives, the composition of the product obtained from distilling needles and twigs together is not seriously affected if only small twigs are included.

The time elapsing from the time the fire was lighted under the heater until the distillate appeared was between two and three hours Seven or eight hours were required to complete the distillation process. The spent needles were dumped from the container by means of a swinging pole which lifted the cylinder from the heater

The oil from the receiver was dried, filtered, and weighed, and the percentage yield based upon the original weight of material in the charge.

The yield from different species of conifers was found to vary greatly, as follows

	Yield per cent.	
Longleaf pine (Pinus palustris Mill.)	0.[illegible]–0.[illegible];	ave. 0.491
Cuban pine (P. heterophylla Sudw.)	0.264–0.376;	" 0.271
Western yellow pine (P. ponderosa Laws.)	0.060–0.195;	" 0.112
Sugar pine (P. Lambertiana Dougl.)	0.0[illegible]–0.120;	" 0.084
Digger pine (P. sabiniana Dougl.)	0.0[illegible]–0.103;	" 0.066
Lodgepole pine (P. contorta Loud.)	0.[illegible]	
Douglas fir (Pseudotsuga taxifolia)	0.11–0.20;	" 0.168
White fir (Abies concolor Parry)	0.[illegible]–0.[illegible];	" 0.1[illegible]
Red fir (A. magnifica Murr.)	0.1[illegible]	

In addition to the oil it is possible to obtain from the needles a fibrous product known as pine wool. Pine needles consist of thread like bundles of tough fibrous material which provide the strength and pliability of the green leaves If distilled without preliminary chopping the spent leaves can be freed of the non fibrous material by boiling in a soda solution, followed by a series of washing drying and heating operations. The resulting fiber representing some 13 per cent of the fresh needles is fine, strong, and elastic, resembling hemp and can be curved, felted or woven Though darkened by the soda treatment it can be bleached and afterward dyed if desired The long needles of some of the southern and western pines are particularly suited to the manufacture of this fiber Since the leaves cannot be chopped it is necessary to crush them in order to free the oils

At the World's Industrial and Cotton Exposition at New Orleans 30 years ago, one of the exhibits was samples of pine needle products from North Carolina In this collection was pine hair for upholstering purposes, being "so prepared as to preserve the balsamic odor another grade for use as a substitute for hair in plastering, some pine wool which was claimed to be the nearest approach to natural wool ever made from vegetable fiber and intended for spinning and weaving into mattings and carpets, and represented to take and retain dyes without a mordant

In Bulletin No 13 of the U S. Division of Forestry published in 1896, Dr Charles Mohr makes the following statement regarding the utilization of the needles of longleaf pine: "The green leaves of the tree furnish by distillation an essential oil of balsamic odor closely resembling spirits of turpentine. The so-called pine wool is made from their cellular tissue, being heated with a strong alkaline solution at boiling heat, the remaining fiber being cleaned and carded This pine wool is used in upholstery, and is said to be of value as an antiseptic dressing for wounds. Of late years it is manufactured into various kinds of textile fabrics. One fabric is a carpet which resembles cocoa matting somewhat, but is closely woven and is naturally of a rich brown color and very durable. This industry, only recently established, has already met such success that the manufacturers have added twenty nine looms to their work."

In 1904 U S Patent No 758,874 was granted to two residents of Grants Pass Oregon, covering a method of treating pine needles One of the claims reads "Subjecting pine needles to the action of steam to liberate the oil and obtain the extract, crushing the needles to remove the wood from the points thereof converting the crushed needles into fiber, shaking the fiber and sifting the same to remove dust and waste, and washing wringing and drying the fiber" A company was incorporated and a plant said to have cost $50,000 was erected at Grants Pass After a few years the undertaking was abandoned and has not been resumed

It is interesting to note that, coincident with the investigations of the U S Forest Service, the Forest Research Institute at Dehra Dun India, is urging the utilization of chir pine (*Pinus longifolia* Roxb) for the production of pine needle oil and other products

It was found that chir needle oil is of standard composition, and the content is 0 57 per cent based on green weight or 1 4 per cent calculated on dry material On the basis that a tree produces 400 pounds of needles yielding 0 57 per cent of oil, it is estimated that the Kumaun Circle alone could produce 45 600 pounds of oil, or about 5 000 gallons It is proposed to divide the work between a number of small portable distilleries located near felling areas. A typical distillery would consist of one portable boiler of 5 N H P, a battery of two stills worked by it, with a capacity of 400 pounds each. With two charges a day the yield would be 9 12 pounds of oil per day or about 25 gallons of oil per month of 25 days. The coöperation of the medical and sanitation departments is urged with a view of creating a good demand for the oil and by products

Wooden retorts for distilling pine needles at Carlssons Enka Plant, Jönköping, Sweden. Boiler-room shown at right

Deriving Fat from Yeast

By Our Berlin Correspondent

AT the recent meeting of the Experimental and Academical Brewery Berlin, Prof Delbrück made a startling announcement It had been, he said, the constant endeavor of those attached to that establishment, from the outbreak of hostilities to utilize yeast not only as a producer of albumen but for yielding fat. Now a pupil of the Institute of Fermentation Industries, Herr Schrettkensager, had sent a package from the trenches the contents of which turned out to be a dried fungus mass On examining this under the microscope Prof Lindner found each individual cell of it to be filled with a drop of gelatine The fatty yeast so long sought had at length been discovered

On further examination the yeast proved to contain 18 per cent fat and 30 per cent albumen Expert advice goes to show that already a product containing 10 per cent fat could be worked on a commercial scale with good results Attempts were at first made to cultivate the new yeast according to the same process as albuminous yeast, but in accordance with its special character, it was found to require much rest, and, therefore, it was reared in thick layers on iron plates.

The Fats and Oils War Committee, which was immediately informed of the discovery showed its great interest in the matter by awarding a considerable sum It is thought that the discovery will even during the period of the present war reach a stage of practical utilization

The large-scale production of fodder yeast is likewise proceeding most satisfactorily

One of the establishments where Italian boys and girls prepare compressed newspaper fuel for their soldiers in the mountains

Method of cutting a rod of compressed newspapers into small pieces. The pieces are afterwards placed in individual bags for distribution

Waste Newspapers as a Fuel for Military Camps

ITALY has aptly and inexpensively solved the problem of supplying her soldiers, who are campaigning in the mountains where dry wood is scarce, with suitable fuel for their camp fires.

In all the leading cities of Italy there have been organized bands of boys and girls who go about collecting all the discarded newspapers they can find. These are brought to establishments where other boys and girls convert the sheets of paper into solid rods of fuel, under the direction of women teachers. These are then cut into short lengths and packed in individual bags for distribution among the soldiers in the mountains.

It is said that the compressed paper fuel is not only entirely satisfactory for the purpose intended but also most convenient. Should a soldier desire a little hot soup or coffee he only requires three or four pieces of this unique fuel to heat the food. Lightness is another consideration in favor of the improvised fuel, especially in the mountains where weight is a paramount factor.

Transportable Bungalow Drawn by Runabout

TO provide himself with a comfortable shelter at all times while on his journeys about the countryside engaged in distributing religious literature, S. W. Beasley, of Pomona, Calif., has had built for his use a transportable bungalow that is drawn by a light runabout. The method employed in distributing the weight of the transportable shelter as well as in the application of driving power to the wheels makes this odd road train of more than passing interest.

A careful examination of the two accompanying illustrations reveals the fact that the rear wheels have been removed from the runabout. In their place is a jack shaft provided with a differential. The runabout frame is extended back to make the front wheels of the house serve as the middle set of wheels for the train. Strange as it may seem, the automobile is not marred in the least and it can be changed back into its original form within 20 minutes by removing the sprocket wheels and disconnecting the extension. When the owner arrives at a community where he desires to carry on his extension work, he can disconnect the bungalow member of the equipment and ride about the locality in the runabout.

The shelter, which the owner calls an "automobungalow," is most complete and comfortable. Its sleeping accommodations comprise one full sized and three three quarter sized beds. When these are folded up there is a curtain on the inside which serves to shut them off from the living room. On the other hand, when they are folded down the same curtain forms a roof and separate side curtains can be buttoned on to completely enclose the bed with canvas. At one end of the bungalow is a gasoline range, with a sink beside it. Hot and cold water is forced up from a tank under the house by means of an air pipe fed by a bicycle pump. Above the sink is a china closet while to one side is a linen closet and a cooling closet. In the middle of the room is a collapsible dining room and library table. A dressing room of about the same size as a telephone booth is placed at the opposite end of the house, and in one side of it is installed a clothes press. Just outside the dressing room is a built in writing desk, with a mirror over it. Beneath the desk is a built in book case. The accommodations, it is believed, will comfortably house five people.

"Day and Night" Danger Signal

NOTWITHSTANDING the fact that the red lamp or flag is being supplanted as a danger signal to a great extent, it will be several generations before red has ceased to be popularly regarded as an indication of the presence of peril. The red light has been made use of in the design of an entirely new type of railroad warning recently built by the Southern Pacific Company. The feature of the signal is the fact that the red lamp is utilized as a daylight signal as well as for night use. Ordinarily a red light which shines out at night, cannot be seen when the sun is in the firmament above, but this red lamp is placed to the rear part of a 3-foot tube which is suspended in a horizontal position on a post at a point about on the level with the eye. This device constitutes a distant signal principally for warning automobilists of the presence of the crossing which is 100 feet beyond. The open end of the tube is pointed away from the crossing so that the point of red light is seen clearly in the center of an inky circle by the chauffeur when he is several hundred feet away from the tracks, where he has ample warning to look out for trains. As a further means of attracting attention, there is a large disk surrounding the tube which is painted red with white stripes. The first of these signals were erected at the crossing in Tropico, Cal., and the device has been regarded with so much favor that its use will be extended to other points along the line.

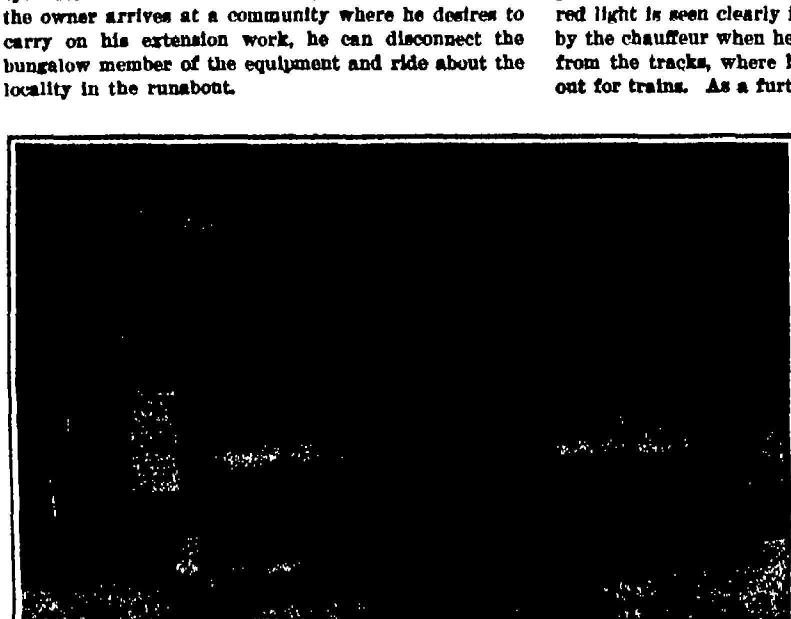
An Easy Way to Waterproof Clothes

HUNTERS, fishermen, and other lovers of out-door life, may find it to their advantage to take a leaf from the advice of the French Academy of Science to soldiers on the subject of waterproofing their garments. The process recommended is simple and easy, durable, inexpensive, and does not injure the appearance of the clothes. It consists, according to *La Nature*, of a very slight impregnation of the fiber of the cloth with wool fat. This is dissolved and diluted in a neutral, anhydrous, and volatile liquid. One takes 5 to 10 parts of *Adeps lanae*, procurable at almost any drug store, liquefies it in a little chloroform and dilutes with 90 to 95 parts of gasoline (*essence of petrol*). The entire uniform, braid, buttons, and all is immersed in it, squeezed or stirred in it for a few minutes, then wrung out and dried in the air.

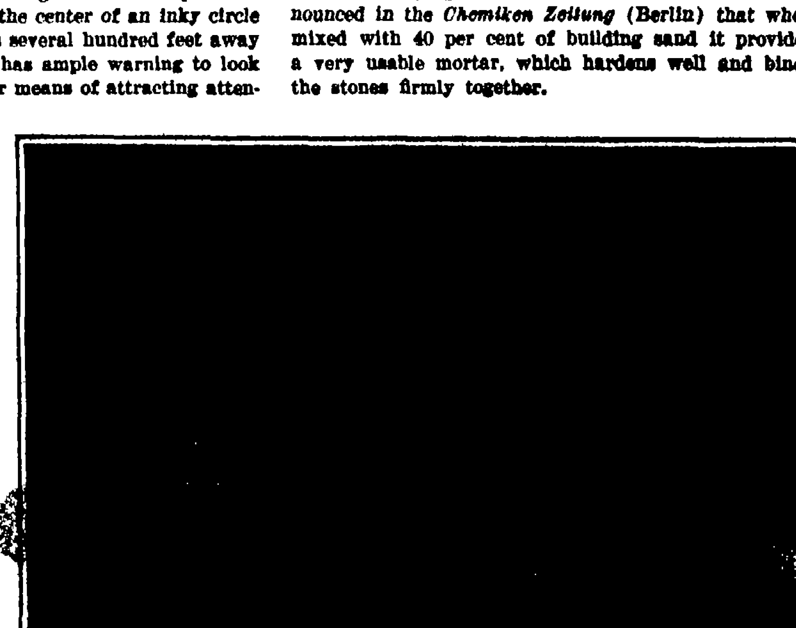
The woodsman may complete his preparations to defy wet weather by giving his heavier equipment, bags, leggings, etc., another treatment recommended in the same journal to render articles of coarse cloth or canvas impermeable. Such articles are smeared thoroughly with a mixture of talc with 50 per cent vaseline. Red vaseline is best, since it costs less and gives an attractive khaki color. The paste is applied much like shoe blacking, and is then rubbed in vigorously with a brush to make sure of an intimate contact.

Mortar from Carbide-Mud

IN the production of acetylene gas from the union of calcium carbide and water, the residue consists of a considerable amount of "carbide-mud." Hitherto this has been considered useless, but the increased use of acetylene during the war has resulted in such large quantities of this by-product that German chemists have been trying to find a use for it. It is now announced in the *Chemiken Zeitung* (Berlin) that when mixed with 40 per cent of building sand it provides a very usable mortar, which hardens well and binds the stones firmly together.



The "automobungalow" at rest, showing how the beds are arranged when in use



The "automobungalow" or motor-hauled house in transit from one community to another

View in the mountain districts of the Philippines, showing the man-made terraces for the cultivation of rice

Floating water mill used in the Caucasus, which continually changes its location in accordance with its trade requirements

Rice Terraces of the Philippines

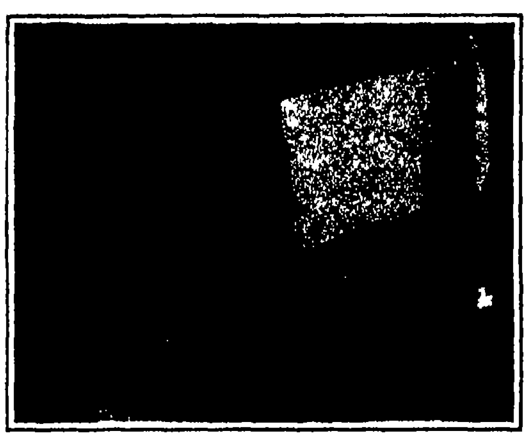
RESEMBLING the great works of Nature such as the Grand Cañon of the Colorado and Yellowstone Park, the rice terraces in the mountain provinces of the Philippines appear to be the result of erosion or glacial action rather than the work of humanity. Yet they are absolutely artificial, the mountain sides being terraced by the patient labor of the islanders so that rice can be grown on the slopes of the precipitous ranges. The rice terraces extend for almost countless miles and are by no means haphazard in their arrangement. In fact, an officer returning from the Philippines described them as marvelous engineering feats, since the water from the upper terraces is carried from level to level on easy grades, breaking the force of the current and irrigating mile after mile of rice fields.

Home-Made Phonograph Possessing Good Tonal Qualities

THAT a phonograph of good tonal qualities can be made from an ordinary pin and a shingle was demonstrated recently by the engineers of the State University of Iowa in their annual exhibition, when such a machine delighted hundreds of visitors with its rendition of popular airs. Strange as it may seem, a phonograph made after the pattern of that shown in the accompanying illustration will compare favorably with many of the machines on the market and is far better than the early attempts of the talking machine inventors.

Since the illustration clearly shows the construction of a shingle phonograph, but little explanation is necessary. Perhaps the most difficult step in the work is the mounting of the record so that it will run smoothly and at the right speed. In this instance an electric battery motor is used as the driving power, the speed being controlled by the number and strength of the cells used. If the builder of the phonograph is sufficiently ingenious, he can make a rheostat or wire resistance which is inserted in the battery circuit, or, failing in this, a rheostat can be purchased at a moderate cost. Careful attention must also be given the belting connecting the motor pulley to the revolving table. If the motor is of unusually high speed, it will be necessary to reduce the speed in two steps which can readily be done by the use of large and small wooden pulleys. It will be noted in the machine illustrated that the reduction in speed is effected by the difference in ratio between the motor pulley and the grooved wooden disk serving as the revolving table for the records. The materials needed in making the phonograph are knitting needles, quarter inch hard wood boards, small nails, battery motor, battery, string for belting, and a washer, nut and screw to clamp down the records on the turntable. Instead of using ordinary pins as the reproducing styluses it is advisable to employ the conventional forms of phonograph needles, but as to the particular variety of needle best suited it is impossible to state, since it depends largely on the weight placed on the stylus by the shingle used.

From the standpoint of the experimenter, the simple home-made phonograph possesses advantages in that its speed can be varied over a wide range and it can be operated with equal ease in either direction. Thus a record can be rendered in the manner intended and then in the opposite direction. The novelty of hearing the records in the contrary direction affords almost endless amusement and doubles the entertainment value of each one.



Experimental phonograph using a shingle to impart the sound waves to the air

Water Mill Built on a Boat

THERE is in actual use on the Kura stream in the Caucasus a water mill which does not follow conventional practice in that it is continually changing its location. To render its transportation a simple matter, this mill is mounted on a boat like body as may be seen in the accompanying illustration. Heavy booms and chains are used to anchor the floating mill at any desired point.

Although the traveling water mill would appear to be more of a curiosity than a practical plant, still it possesses the one striking advantage that it does not have to wait for work to be brought to it, but instead goes forth and seeks its work. It remains at one point until the available amount of work is exhausted, whereupon it moves up or down the stream in search of new trade fields.

Collapse of a Municipal Lighting Tower

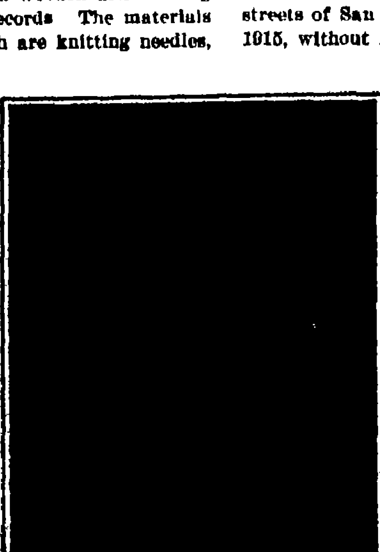
FIFTEEN tons of structural steel fell from a height of 200 feet at the intersection of the two principal streets of San Jose, California at noon, December 3rd, 1915, without injury to anyone or the crushing of adjacent buildings. The steel was in an immense electrical tower, which had long been a feature of the city. For nearly a year the tower had been in disuse by reason of damage by storm. Repair work had been in progress for several weeks, the structure had been wired, the illumination tested, and it was soon to be turned over to the municipality by the contractors when it collapsed under the stress of a 60-mile gale, which exerted a pressure of 23 tons against the corner posts.

Fortunately the snapping of brace-rods and an ominous swaying of the tower gave warning to pedestrians to get out of the way. Two automobiles, however, drove beneath the tower at the moment of its collapse, the drivers saving themselves by quick bursts of speed. A broken trolley wire writhed in the street for several minutes, sending up a sheet of blue flame. The crash was heard for many blocks.

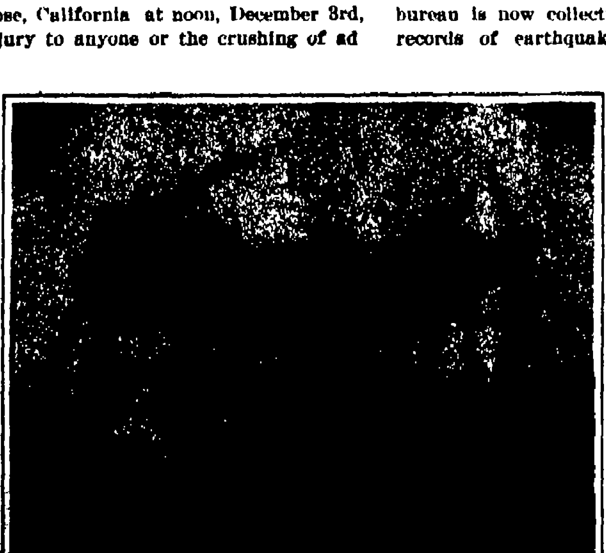
The tower was an historic structure, having been built in 1881 when the city was first lighted by electricity. After it had been demonstrated that such method of lighting was less desirable than street lights, it was retained because of its unique character and the distinction which it gave the city. One leg of the immense structure stood at each corner of the square, all traffic passing beneath the skeleton, which tapered to a point 200 feet in the air. For 33 years the tower with stood the heavy gales of that region, but in February, 1915, was so badly damaged that it had to be taken down about half way.

During the subsequent months the tower was rebuilt at a cost of $6,100, the fund being raised by subscription. A public dedication ceremony had been planned and was scheduled to take place within a few days. It has now been decided not to rebuild.

Investigations following the collapse disclosed that the main beams had lost much of their original strength and resiliency and that they were unable to withstand the weight of the new work above. This condition was ascribed to natural disintegration and to the constant vibration caused by traffic. In falling, the tower seemed to twist and crumple, the bulk of the debris crashing upon a staging which had been built to a height of 40 feet.



Illuminated municipal tower of San Jose, Cal.



Ruins of the tower following its collapse in a 60-mile gale, on December 3rd, 1915

American Seismographic Observations.

IN gratifying contrast to the neglected and uncoordinated state of seismological work in North America a few years ago it is noted in the current annual report of the Chief of the Weather Bureau that the bureau is now collecting and publishing instrumental records of earthquakes from the following places: Sitka, Tucson, Honolulu, Cheltenham (Md.), Porto Rico, Point Lomo (Cal.), Denver, Georgetown (D. C.), Lawrence (Kans.), Cambridge (Mass.), St. Louis, Buffalo, Fordham (N. Y.), Balboa Heights (C. Z.), Ottawa, Toronto and Victoria. The institutions furnishing these reports include stations of the Coast and Geodetic Survey, various universities and colleges, and the Canadian meteorological service. The Weather Bureau maintains seismographs of its own at Washington and at Northfield, Vt. Besides these instrumental records, the bureau collects non-instrumental reports of earthquakes from all its 200 regular stations and from most of its 4,500 co-operative observers, and these are published regularly in the *Monthly Weather Review*.

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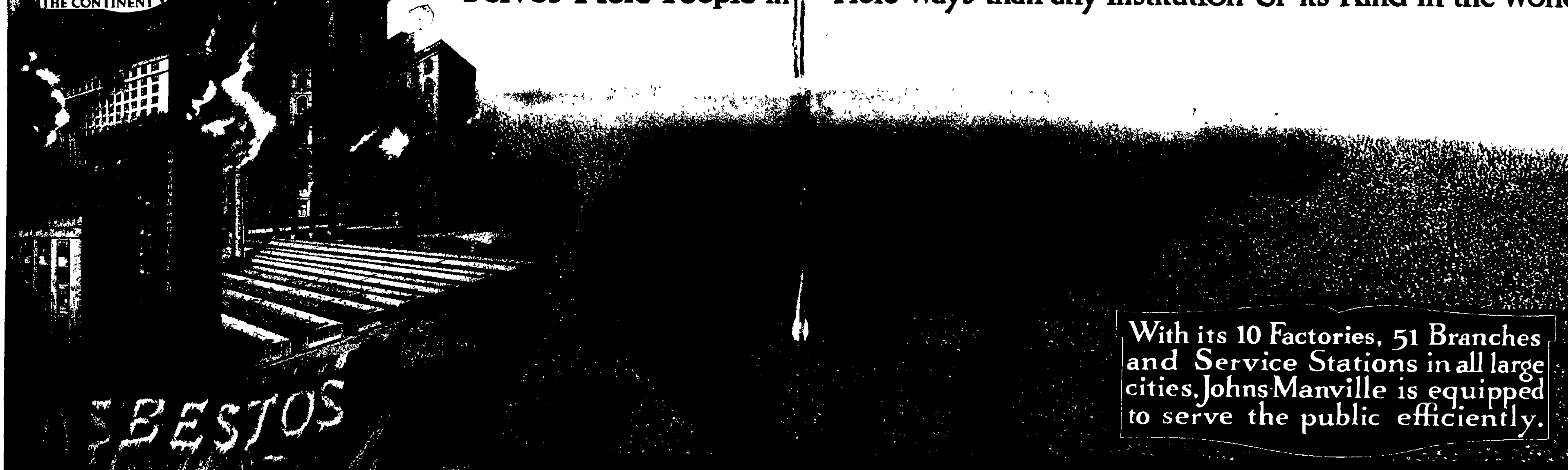

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The Motor-driven Commercial Vehicle

Conducted by VICTOR W PAGE, M. S. A. E

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles

One-Wheel Electric Tractor

A CHICAGO manufacturer has just perfected a one-wheel tractor arrangement intended to convert horse-drawn wagons into electrically propelled trucks The attachment consists of a single wheel constructed of cast steel and equipped with a 3½ inch dual solid rubber tire of the usual pattern used on trucks The electric driving motor is located in the interior of the wheel and delivers its power through a pinion at the end of the armature shaft which engages a large gear attached to the interior rim of the wheel As the motor is carried inside of the wheel, it is completely protected from the elements The motor is a standard type and both sides of the wheel are so arranged as to permit ready removal when the motor requires inspection or lubrication or when repairs are necessary It is not necessary to remove the side plates to inspect the mechanism in the wheel interior as an accessible door in one of the wheel sides provides every opportunity for inspection

The vehicle is steered by the usual form of handwheel which operates a pinion engaging in a gear arranged on the circular frame which carries the traction member When the frame is turned the proper degree of wheel angularity is secured to obtain the desired direction of movement A foot actuated lever operates the brake the retarding force acting on a brake drum on the end of the front axle The entire apparatus is securely attached to the body of the vehicle by means of steel frame bars or perch rods extending from the front to the rear, which also act as supports for the storage battery container which is carried under the vehicle body

When the tractor assembly is in place a substantial front drive electric vehicle having as much power as the average electric truck is obtained The attachment can be applied to any vehicle at a low cost and should make possible motorizing fleets of horse-drawn delivery wagons by those firms who would otherwise be disinclined to sacrifice a good horse-drawn equipment to purchase complete electric vehicles of the conventional type The attachment offers many of the advantages of the usual motor truck, as its tractive power is sufficiently great to draw any vehicle to which it can be conveniently attached and, because of the efficiency in transmission, it is claimed that a greater mileage can be obtained from the storage battery The use of one combined traction and directive wheel eliminates a differential, universal joints some power transmission and speed reduction gears and steering knuckles This construction makes possible the use of standard vehicle springs, the regular wheels and rear axle and small rubber tires on the rear wheels, which amounts to considerable saving For slow speed vehicles such as used in municipal service for street cleaning, garbage disposal etc steel tires can be used on the rear wheels

Useful Winch Attachment

TRUCKS that are used in handling heavy materials that are difficult to load or unload by man power are sometimes provided with a hoisting winch and boom The truck illustrated herewith is used by the city of Detroit in the street lighting department and is employed for conveying materials of construction. The utility of the winch and boom is apparent as it is shown hoisting a heavy cast iron lamp post and assisting the workmen in placing it The hoisting drum is driven by the truck power plant through the medium of a manually controlled clutch The winding drum movement is retarded when desired by a hand actuated brake The winch arrangement is placed immediately back of the driver's cab in the space just ahead of the truck body A vehicle equipped in this way should be very useful to any contractor

One-wheeled-tractor designed to convert a horse-drawn vehicle into a motor truck

A power-driven winch mounted as part of the motor truck

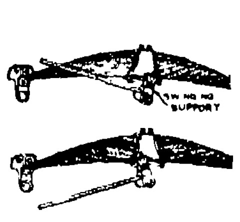
Variable Springing

AN English engineer has recently devised a scheme for varying the strength of the load-carrying springs to suit the different running conditions and, while initially contrived for and used on the lighter private cars and confined to a cantilever spring it seems to be a development in the right direction As shown in the accompanying sketch the action depends upon the principle that a shorter spring is stiffer than a long one and that the period of spring movement depends upon its length. A short spring will have a quick period, while a long one will be slower in action. The usual cantilever spring is shackled at its front end and is secured to a rocker joint about midway of its length. This type of spring has its action checked by the shackle at the front end The working of the cantilever spring depends to some extent upon the length ahead of the oscillating fulcrum being less than that of the spring from the fulcrum point to the rear axle The rear part of the spring is actuated by the lighter and less rapid road shocks, while the front part acts under the stiffer and more rapid stresses. The system of spring variation depends upon changing the length of the two parts of the spring, more particularly that of the back end by a swinging support which changes the fulcrum point and consequently the characteristics of the spring

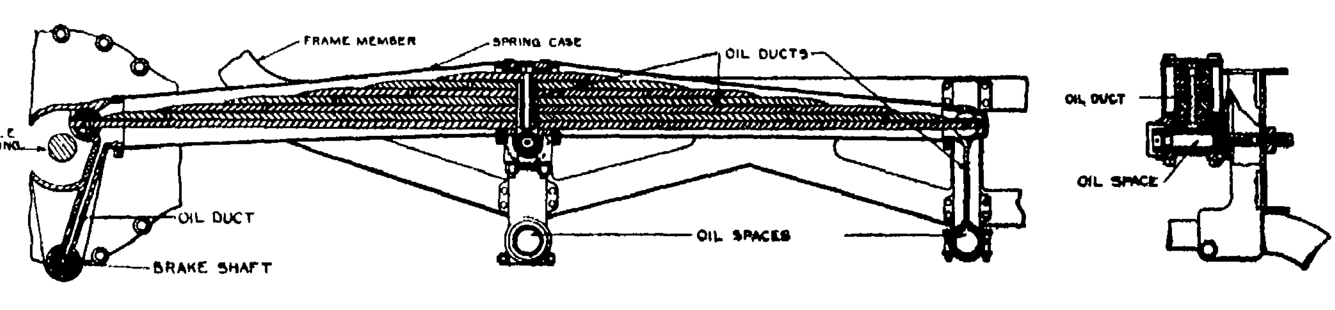
An Automatically Lubricated Chassis

IT is a matter of common knowledge to those familiar with the repair of motor trucks that a large part of the mechanical depreciation and many of the break-downs which occur are brought about by failure to properly lubricate the parts. On the average commercial car chassis there are a large number of minor though important working points that should be oiled daily These are either provided with small oil cups to be filled with a hand oil can or syringe or screw down grease cups. Many of these are located in relatively inaccessible places and it is certain that they will be neglected. A new pleasure car chassis has recently been developed in England in which the matter of lubrication has been carefully worked out by the designer so that practically all of the moving parts are lubricated automatically by the engine A comparison made between a chassis of conventional design and that of the new car shows that there are but eleven points requiring attention as against the fifty or more parts on a chassis of the usual construction The only daily attention required of the driver of this distinctive car is to keep the oil level in the engine sump up to the required height. The lubrication of the other points need not be performed more frequently than once in six months

This factor of automatic lubrication, while first applied to a pleasure car should receive the careful consideration of the truck designer as well, especially when one considers that many truck drivers are mechanically inexperienced Automatic lubrication is not only preferable because it saves time, but also because it insures lubricating parts that would not otherwise receive attention. A car in which the engine is made to feed filtered oil to the center of practically every moving part is desirable, because with such a design mechanical depreciation and consequent repair bills will be reduced to a very low point. The lubrication of the entire interior of the engine by circulating the lubricant from a sump or oil container integral with the engine has been common practice on both sides of the water for a number of years To utilize this same oiling system for lubricating the change speed gearing, rear axle and such usually neglected parts as the springs, brake rods, etc., is certainly novel and distinctive.



Variable spring suspension



Sectional views showing how the springs are automatically lubricated in the new English chassis

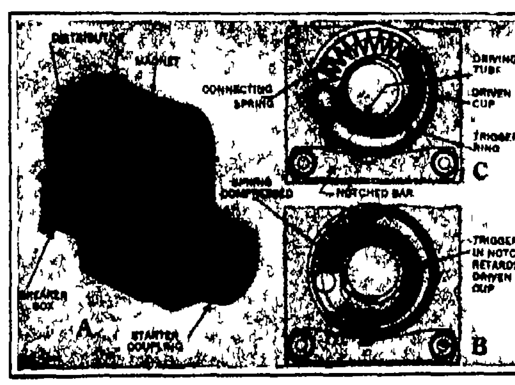
The oil sump incorporated at the base of the engine is of larger capacity than that ordinarily provided. The lubricant passes through a filter before it reaches the pump and is delivered from that member under a pressure of about 20 pounds to the square inch (when the oil is hot), to the center crankshaft main bearing, whence it passes through the hollow shaft in either direction and lubricates the entire interior of the power plant in the conventional way The internal oil channel between the oil pump and the filter is tapped and an oil pipe is led from this to feed all of the small moving parts of the chassis other than the hand brake quadrant and the steering joints This pipe runs completely around the car inside the channel of the frame and returns to the engine base

At the points where the pipe passes the four brackets to which the centers of the cantilever springs are pivoted, small steel branch pipes are let off and enter the centers of the spring fulcrum pins Each of these spring fulcrum pins is drilled throughout half its length and the oil feeds from the inner end of this channel through a small hole drilled downwards at right angles to the outer surface of the pins and its bearings. The hole is normally sealed by the pressure of the fulcrum pin on the lower half of the bearings, but when the springs are working, some of the oil seeps out through the hole around the pin and along an oil channel drilled through the centers of all the spring leaves, except the short top leaf The leaf immediately below the top leaf has on its upper surface shallow grooves extending in each direction from the center to within a few inches of its rounded tips and the oil finds its way down these grooves from one spring leaf to the other as clearly shown in the accompanying illustration Each spring is bound in a leather case to keep the oil in and the dirt out These leather cases are held on by clips against properly formed flanges The anchorages of the cantilever spring ends are of the sliding type, no swinging shackles being fitted

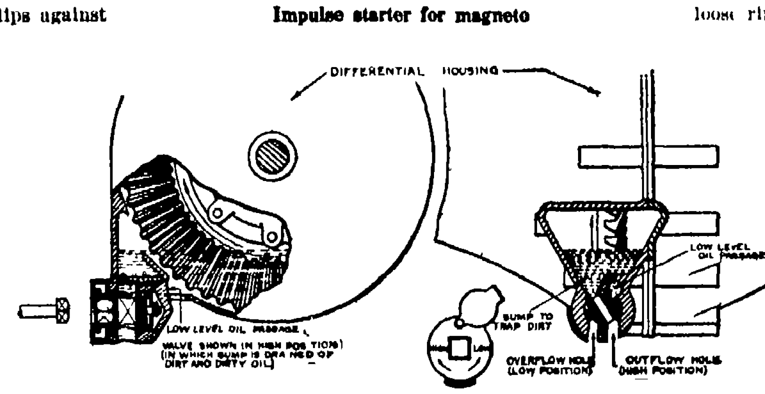
After passing along the spring leaves, the oil passes to the brake actuating shaft from the front end of the rear spring, while from the rear end of the front spring the oil goes to the clutch and brake pedal cross shaft. The rear ends of the back springs project into the back axle casings and oil leaking from the rear springs keeps up the level of lubricant in the rear axle The steering joints for both the fore and aft and cross rods are lubricated from oil contained in the hollow rods themselves A section of the tie rod showing the ball joint and the filler plug is shown at B in the accompanying illustration. The tie rod is filled every six months and no further attention is needed as the ball joint is not only copiously lubricated, but is well protected with dirt-excluding closures The interior of the hollow front axle also communicates with the drilled pivot pin and any lubricant forced into the axle must not only lubricate the steering pivots, but the front wheel bearings as well

As much of the oil from the chassis parts flows into the rear axle it is apparent that some dirt must be carried into that member This is very well taken care of by providing a sump on the rear of the differential housing which collects dirt splashed up against a deflector by the revolving gear, provision being made for draining this sump from time to time as desired. Considerable attention has been devoted to the designing of oil tight joints. It would not be practical to devise a lubrication system of this nature if the oil could escape from the bearing points lubricated as quickly as it does with the ordinary type of car A sealing cap is provided on the outer extremities of practically all of the lubricated joints which is very much the same as a standard road wheel hub cap, except that it is on a small scale It should be realized that the care taken to retain the oil means that dirt will be excluded as well

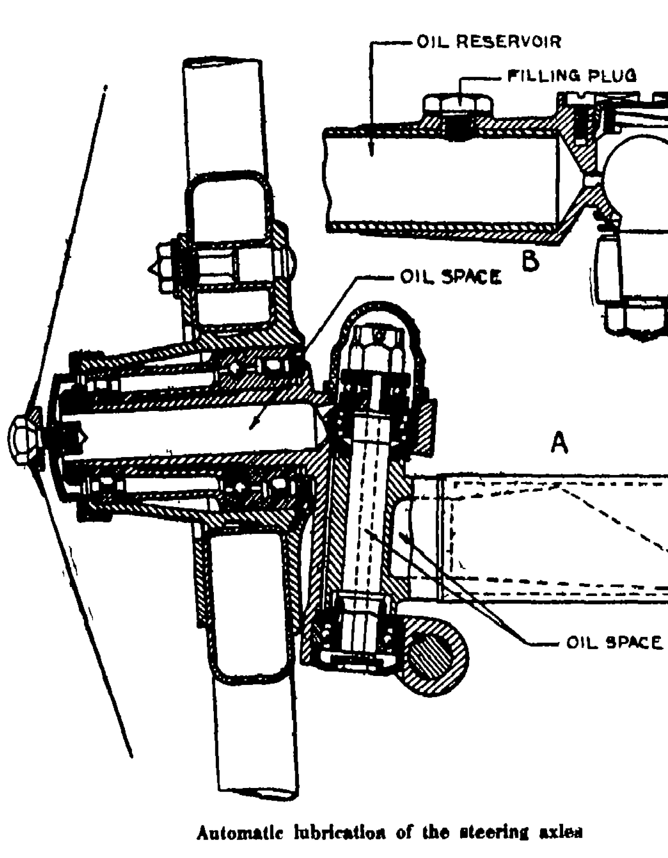
Space does not permit an extended description of this ingenious lubrication system but the writer can see no reason why a refinement of detail such as shown in the accompanying sketches, could not be worked out to advantage on a motor truck chassis. It would seem possible that many of the chasses as at present designed could be made self lubricating without much trouble Wherever tubes are used the interior of the tube can be used as an oil reservoir which need not be filled very often This is especially true of the joints on the steering connections which are grossly neglected at the present time and which wear rapidly as a result of this neglect. It appears that the ball joint, such as shown at B is not only the best form for steering connections, but it could be used with equal advantage at the ends of the brake rods, radius or torque members or, in fact, for any joint where a free acting, long lived and easily adjusted connection is desired It would be infinitely superior to the usual simple yoke and pin arrangement which is now standard practice Even without going to the extreme refinement of detail as displayed in the new chassis, many of the joints could be enclosed in leather cases which could be filled with a semi fluid lubricant Automatic lubrication of all chassis parts is of paramount importance on vehicles intended for commercial work and should be carefully studied by all motor truck designers Further truck development must be more in the line of refinement of details rather than in any startling innovations in power plant or chassis construction and nothing could be of more importance than insuring proper lubrication of the mechanism and reducing upkeep costs



Impulse starter for magneto



Method of lubricating the differential



Automatic lubrication of the steering axles

Motor Truck Queries

W P Y writes I have a large truck equipped with a 60 horse-power four cylinder engine The ignition is by high tension magneto, set spark No batteries are provided I find it difficult to start the engine on cold mornings because the cylinders are so large I cannot "spin" the engine even with the decompressor open Do you believe the fault is in the magneto? Do you think an auxiliary battery ignition system would help matters any? A An auxiliary battery system would make the engine start easier providing the trouble is not due to the mixtures being too thin First try a little richer mixture than you have used during the summer Try priming the cylinders with gasoline before trying to start the motor by cranking Have the spark time advanced slightly A battery system will be expensive as you will need a special form of magneto for either dual or duplex ignition though a one coil distributor system may be installed providing there is any place you can attach the distributor where it will be driven at the correct speed The maker of your magneto may be able to change this over to a dual system which will be the easiest way to obtain the advantages of the battery system in securing an easy start Special forms of couplings as illustrated herewith may be used to drive the magneto armature This provides a hot spark even when cranking slowly as the armature speed is accelerated by a spring arrangement so the speed approximates that obtained when the engine is turning over under power The device is said to have no effect upon the regular operation of the magneto except at slow speeds when it causes the armature to rotate in a series of jumps instead of at a uniform speed These jumps cause the armature to cut the lines of force of the magnets quickly or at the same speed that it does when the motor is revolving swiftly so that a hot spark is generated This removes any necessity for auxiliary battery ignition for starting heavy duty motors, for a hot fat spark is generated at any speed regardless of how slowly the crank is turned

The coupling consists of a driving tube in the center and a driven cup inclosing the device the two being connected by a spring Within the driven cup is a loose ring, known as the trigger this ring having a lip which extends through a slot on the periphery of the cup At the bottom of the coupling is a notched bar, so positioned that as the cup revolves the notch registers with the slot in the cup so that the trigger lip drops down by gravity and thus locks the cup against the rotation This is the position shown in the lower view On the inside of the trigger ring is a cam which engages a corresponding cam cut in the driving tube When the lip has engaged the notched bar and the cup ceases to rotate, the driving tube continues to turn This turning compresses the spring, which is seated against a driving pin on the tube and a block fixed to the cup At a predetermined point the cam on the trigger ring engages that on the tube and lifts the trigger far enough so that the lip disengages the notched bar and the compression of the spring spins the cup around in a clockwise direction The magneto armature is connected with the cup, and so as the cup spins around the armature is given a quick twist producing a hot spark At slow speed, as the cup revolves it is caught again and again by the trigger but when the motor fires, the speed is so increased that the trigger ring, by its own weight becomes a ring governor, and centrifugal force keeps it from dropping down into the slot. In this state, the coupling acts as a dead connection between the drive and the armature a small lug on the inside of the trigger ring, at the point where the lip juts out, engaging a notch in the driving tube and thus providing a positive drive as long as the speed is maintained The device includes a standard coupling for connection with the shaft

G P writes Will you inform me if the caterpillar tread type of tractor would be suitable on newly cut roads through a timbered country I live in northeastern Oklahoma in the foot hills of the Ozarks and expect to buy a tractor for next summer delivery I expect the machine to pull and run a grain separator, 28 inch cylinder pull five plows in the field and run a small capacity rock crusher and concrete mixer in road making work A The track laying or "caterpillar" tread type tractor should prove satisfactory in every respect for the work you mention In fact, many of the logging engines used over snow covered roads in hauling a train of heavily loaded sledges employ this chain tread traction member They have also been successfully utilized for hauling heavy artillery over very poor partially destroyed roads and even across country We would advise either this form or four wheel drive where traction conditions are not good These tractors may be procured equipped with engines of 50 to 60 horse power

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

CLAMPING AND HOLDING MEANS FOR SHOE UPPERS.—S I DERR, 364 New St, Emaus, Pa. An object here is to provide a device for clamping and holding uppers preparatory to marking the spaces for buttons thereon A further object is to provide a construction which will engage and hold the uppers properly in position while the same are being marked

CHILD'S WAIST.—TILLIE ROSENBAUM, 501 W 149th St New York N Y The invention provides a waist with suspension members expansible to accommodate the growth of the wearer provides garment supporting members to relieve the body from the carrying or supporting strains provides a garment employing shoulder-straps with adjustment devices for retaining said straps in service position on the body, and provides auxiliary supports or retainers for preventing disadjustment of the shoulder-straps of under vests on similar garment

Pertaining to Aviation

AEROPLANE J B GROSS, address Joseph W Connolly 13 E Hamilton Place Jersey City N J One of the main objects of this invention is to provide a relatively great area of sustaining surface another is to provide a positive control of the steering and stabilizing means A further object is to provide means for warping the ends of the sustaining planes in the proper directions and degrees simultaneously

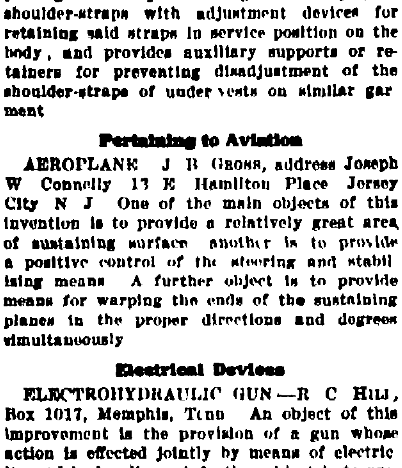
Electrical Devices

ELECTROHYDRAULIC GUN.—R C HILL, Box 1017, Memphis, Tenn An object of this improvement is the provision of a gun whose action is effected jointly by means of electricity and hydraulics. A further object is to provide a gun which may be operated without the necessity of using an explosive charge

Of Interest to Farmers.

ATTACHMENT FOR CULTIVATORS.—G L. MILLER, Address Charles G Davis Lawyer 112 S. State St., Geneseo Ill This invention is an improvement in attachments for cultivators, and has for its object to provide mechanism of the character specified especially designed to destroy and eradicate weeds growing close to the stalk in the row, which are not reached by the shovels of the cultivator

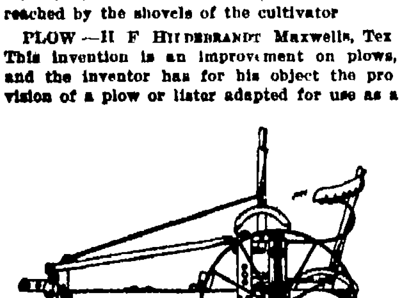
PLOW.—H F HILDEBRANDT Maxwells, Tex This invention is an improvement on plows, and the inventor has for his object the provision of a plow or lister adapted for use as a



PLOW OR LISTER.

riding or a walking plow, wherein a wheel supported frame is provided, and a plow supporting frame so connected that they may be separated to permit the use of the plow as a walking or a riding plow

COTTON CHOPPER AND CULTIVATOR.—J J EARGLE, Newberry S C The invention refers to cotton choppers and cultivators and one of the principal objects of the improvement is to provide such a machine having a rotary



COTTON CHOPPER AND CULTIVATOR.

cutter suitably supported in an adjustable carriage and adapted to be operated from the ground wheels of the machine at various rates of speed

CULTIVATOR.—W F LAMP Mohler, Wash The cultivating mechanism in this mechanism is a series of concave convex disks arranged with their convex faces upward and each provided with a radial vane on its upper face, the disks being mounted in the same plane on a wheel-supported frame and being driven from the wheels of the frame, and being mounted on an auxiliary frame which is adjusted vertically with respect to the main frame, the disks being arranged in a row and spaced apart from each other to permit the rows of plants to move between adjacent disks.

Of General Interest

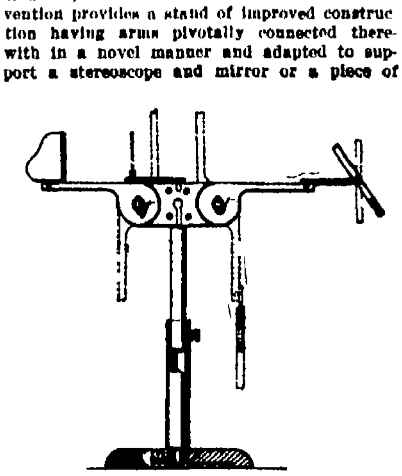
GUN CARRIAGE AND PROJECTILE.—E. E. GREGORY, Lewisport, Ky The invention relates to a device for use in gun carriages to serve as a wad and gas-check in shooting stream line bullets or other projectiles, including bombs The device is cup-shaped, and it may be made in various sizes and modifications in regard to details of shape and construction.

CHEMICAL FIRE EXTINGUISHING SYSTEM.—P B BARRINGER, Charlottesville, Va An object here is to improve the construction of the containing device for the liquid chemicals, so that the mixing of the chemicals can be effectively brought about by the pneumatic pressure in the pipe system through the firing of the explosive material of any nozzle

OBSERVATION APPARATUS.—G T FIELDING, 2186 Loring Place, Bronx, N Y N Y The object of the invention is to provide a new and improved observation apparatus more especially designed for use by military persons and arranged to enable a person to safely observe distant bodies of men or other objects without danger of exposure

CHIMNEY COWL.—H GUTSCHMIDT, 574 Palisade Ave Jersey City, N J This invention provides a chimney cowl arranged to provide a free, unobstructed escape of the smoke coming up the chimney or smoke stack on which the cowl is supplied and to prevent back draft especially when high winds prevail and in case the cowl is located adjacent the wall

ORNAMENTAL STAND.—N Q FRETWELL Route 3, Box 52 Fort Worth Tex. The invention provides a stand of improved construction having arms pivotally connected therewith in a novel manner and adapted to support a stereoscope and mirror or a piece of



ORNAMENTAL STAND

statuary or like article said arms being adjustably connected with the stand and being adapted to be readily revolved about the stand as an axis to bring them into the desired position

Hardware and Tools

WELL DRILLING TOOL.—J V RIDLEY, Sr and A G RIDLEY Water Tower Block, Newport Ark This invention provides a tool which will facilitate the sinking of artesian wells or other small bore wells It also provides a drill point which is designed to be rotated and by means of which the earth is pressed outwardly, thereby facilitating the entrance of the drill point proper

URETHRITIC SYRINGE.—G J DUGGAN, address Becton, Dickinson & Co, Rutherford, N J This invention relates to urethritic syringes consisting of a glass barrel and a rubber bulb for drawing the medicated liquid into the barrel and ejecting it through the nozzle thereof to an affected part It provides a syringe of the type mentioned, and arranged to prevent the liquid drawn into the barrel from flowing into the bulb in holding the barrel with the nozzle upward

Heating and Lighting

FEED WATER PURIFIER AND BOILER SKIMMER.—H M NYE, 2601 R St., Lincoln, Neb. The object of the invention is to provide a feed water purifier and boiler skimmer arranged to readily remove the sediment contained in the feed water prior to passing the latter into the boiler, and to remove oil or other matter floating on the surface of the water in the boiler

GRATE.—C W HOYES, 4 Smith St., Glens Falls N Y In the present patent the inventor employs grate-bars carried by special supporting bars which in turn provide for the upward passage of air therethrough in order to insure fuel combustion directly over the supporting bars as well as over the grate-bars, thereby resulting in high efficiency and complete combustion of the fuel, even though of low grades.

AUTOMATIC RELEASING DEVICE.—A. J TISLEY, 15 Chester Court, Flatbush, Brooklyn, N Y, N Y The device is constructed with a lever on one arm of which a weight is disposed, the other arm being engaged by a shoulder on a second lever, positioned at an angle to the first lever When the second lever is operated it frees the shoulder from the first lever to permit the first lever to move to free the weight, thereupon, thereby permitting the fall of the weight to operate means connected with the feeding apparatus or the furnace drafts.

Household Utilities

HOLDER OR SUPPORT FOR BATH SPRAY PIPES.—G RUBIN, 203 E. 174 St., Bronx, N. Y., N Y This invention is an improvement in holders or supports for spray pipes used in bathtubs, and adapted to be secured to the edge of the same adjacent to the discharge cock Means provide for the bather quickly adjusting the angle of the spray upon his head, shoulder and arms, or upon the lower portion of the body, as desired.

DRAINAGE AND VENT FITTING.—C. S. C ROCK Address M A Farrell, 275 Water St., New York, N Y This invention provides a fitting designed to connect the soil pipe with the vent pipe and adapted to connect with bath tubs, sinks, water closets and other fixtures to be drained and vented, the arrangement being such that the plumber can readily assemble the parts and make the connections so that the proper drainage and venting is insured

WARDROBE.—F N BARDWELL, 98 Howe St., Passaic, N J The main object here is to provide devices which may be moved from one place to another, as a whole, which may be collapsed for storage or shipping, and which presents the unique appearance of an entirely different article of furniture, such as a screen or other article

HINGED RETORT DOOR.—N TROYER And E C FOX, Astoria, Ore. This invention has reference more particularly to a hinged door for use on a retort or receptacle used for cooking fish, fruits, vegetables and food materials by steam, hot water or other artificial means, after the material has been placed in cans, glass jars, or other receptacles.

SANITARY VENTILATED GARBAGE CAN.—E MAYER And M E. WOLFF, 281 Edgecombe Ave, New York, N Y This invention is more especially adapted in connection with a garbage can so as to permit the use of a liquid disinfectant, the odors arising from which will permeate the contents of the can for purpose specified while means are provided to prevent the disinfectant from escaping when the can is emptied

SANITARY CLOSET SEAT COVER.—H. G A MOREN 1250 E 10th St, Brooklyn N Y, N Y This invention has for its general objects the provision of a device which is light, durable, cheap, sanitary and foldable, so as to adopt it for individual use it being foldable so as to be conveniently carried or stored away when not in use

COFFEE MAKING APPARATUS.—A. Mintz 206 E 5th St, New York N Y This invention relates to coffee-making apparatus, and has reference particularly to an apparatus wherein the coffee pots are heated by hot water supplied from a boiler which is external to the coffee pots and whereby economy of burners and, therefore, of fuel is obtained

Machines and Mechanical Devices

INKING DEVICE FOR PRINTING MACHINES.—Jean Carrelet and Laurent D Delonlay, 144 Rue Montmartre, Paris, France This invention obviates several inconveniences and consists in forcing ink or color under pressure through an ink reservoir made of a porous substance which constitutes at the same time the support of a printing block or plate with openings, made of a comparatively non porous substance applied directly to the ink reservoir in such a way that the passage of the ink or color to the printing block or plate takes place to the exclusion of air and it thus becomes possible to employ inks and colors which dry rapidly

BLOW OFF VALVE.—88 Court St., Newark, N J This invention provides a valve structure of a compound nature embodying the characteristics of the now well known check valve to retain the air within the tube and having also an auxiliary valve mechanism permitting any excess pressure over the predetermined degree to be discharged while the first mentioned check valve becomes seated, retaining the precise desired amount of pressure within the tube.

PUMP.—C T HARDING, Fayetteville, Ark This invention provides a plurality of pumps such, for example, as a reciprocity air pump for charging the compressed air tank, and a rotary pump for causing positive circulation of water through the radiator and other parts of the machine, and pumps to be operated simultaneously or otherwise from a single source of power, peculiar means being provided to control the operation of the pumps from said source of power

WATER METER.—H. J WOODMAN, Fort Laramie, Wyo. This invention comprises means for practically automatically registering the amount of water delivered from an irrigation ditch for individual use by the irrigator. A rotary wheel is placed in the water and maintained by the water at a definite elevation below the surface thereof irrespective of the rise or fall of water in the main body or ditch. From this wheel a rotary cam wheel is operated at a relatively slow speed, and the cam wheel checks off the distance interval of water passing through the measuring box which is of definite width. The cam wheel determines the automatic rise and fall of means for [illegible] [illegible] the [illegible] [illegible] [illegible] through the box.

CHECK DISPLAYER.—E. M. [illegible] and [illegible] [illegible], care of George [illegible], [illegible], Iowa. The primary object here is to enable one to compare the amount of the last check inserted into the displayer and that recorded on the cash register. The invention provides a convenient and inexpensive check displayer which will show not only the last check recorded but some of the previous checks.

MECHANOTHERAPEUTIC APPARATUS.—S. J ALBERT, 90 Avenue Secrétan, Paris, France. The apparatus is adapted to strengthen the muscles and to destruct the ankylosis of the members. It comprises a kind of crank provided with a weight and actuated by the person under treatment, either by means of the hand corresponding to the sore arm, or by means of the foot corresponding to the sore leg through the medium of a treadle, so as to cause said sore organs to effect a certain work from which the suitable curative effects will be obtained.

CHANGE MAKING MACHINE.—H. ABRAMOVITZ, 181 Eldridge St., New York, N Y. This improvement relates to coin handling devices and has particular reference to means whereby a cashier may by simple and easily operated mechanism deliver to a purchaser or a customer the necessary change when a purchase is made and a sum of money in excess of the purchase price is tendered.

FRICTION CLUTCH.—H. W LUDLAM, 46 W 37th St, Bayonne, N J. This inventor provides a clutch which acts quickly and effectively to make driving connection between two principal members a certain amount of resiliency between the members as is desirable in many instances, and providing a direct release for relatively reverse movement of the driving member in a noiseless manner

ELEVATOR INDICATOR SYSTEM.—F A. BOETTCHER, 413 W 41 St., New York, N Y This invention relates to improvement in elevator indicators and systems of control therefor, and has for an object to provide an improved structure for causing the indicator at various floors to exhibit information showing the position and direction of travel of the elevator

LIQUID METER.—A. MASS, 225 So. 11 St., Newark, N J The invention provides an apparatus with means for showing the amount received and the amount delivered through said apparatus, counterbalances unpremeditated pressures exerted by the fluid when being passed through the motor and furnishes an index for informing as to the condition of the supply of liquid on hand and the total consumption of liquid passed through the meter during an extended period.

Musical Instruments

TUNING FORK AND RESONATOR.—W BERRY, 178 Schenck St., North Tonawanda, N Y This invention relates to musical instruments of the percussion type, and its object is to provide certain useful instruments of this type whereby a free ejection of the sound waves is had from the resonator and the volume of the tone is increased.

Prime Movers and Their Accessories

CARBURETER.—B H. BIAYS, 52-54 Union St., Cumberland, Md. The object in this case is to provide a carbureter in which the fluid fuel is delivered into the mixing chamber in a thin stream, together with a stream of air immediately adjacent, thus providing for a most intimate mixture of the gas or vapor and the air

CARBURETER.—E. H. ARQUEMBOURG, 71 Rue du Moulin Vert, Paris, France. This invention has for its object a system of car bureter of the type called "multiple carbureter," comprising two carbureters which combine their actions so as to give at any moment the carbureter suited to the proper operation of the motor as well when working at a reduced speed as when working at high speeds.

Pertaining to Vehicles

STEERING DEVICE FOR MOTOR VEHICLES.—D J SANDHAM, 1561 Cornelia St., Brooklyn New York, N Y This steering device is of substantially universal application to all known types of vehicles, that is to say, Mr Sandham's steering devices are adapted to be readily applied by any mechanic to practically any vehicle running gear now in use or type of vehicle now being made.

AIR PUMP.—A. R. BENCK and FRED TJADEN, address the latter, Hastings, Neb. The main object in this case is to provide an air pump provided with a self-contained storage chamber for compressed air, whereby the air is continuously forced through the relatively small valve of the tire, regardless of the direction of movement of the pumping element.

ATTACHMENT FOR STEERING MECHANISMS.—R. L. WOOD, Russell, Kan. An object here is to provide a strong and inexpensive device which will not require any alteration in the steering mechanism of a self-propelled vehicle when applied thereto, and which contrivance can be easily and quickly attached to the steering mechanism.

ATTACHMENT FOR CONVERTING A BICYCLE INTO A TRICYCLE.—J. C. [illegible], [illegible] [illegible] Ave., Bronx, New York, N. Y. Mr. [illegible] invention has reference to [illegible] [illegible] the converting a bicycle into a tricycle, and it

[illegible] provision [illegible] particular [illegible] a bicycle [illegible] The invention provides an auxiliary attachment whereby the ordinary [illegible] can be easily and quickly changed into a motorcycle, and vice versa.

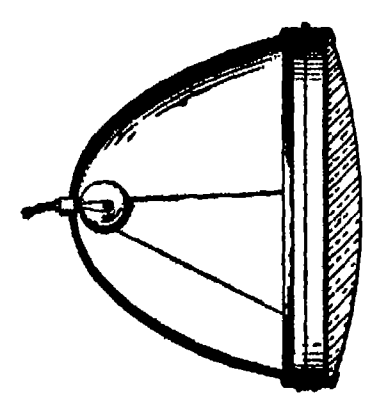
AUTOMOBILE JACK.—F O. COOLEY, and A. J. [illegible], care of Clyde Iron Works, Duluth, Minn. This improvement relates to jacks of the type in which provision is made for jacking up both the front and rear axles of the vehicle. It provides automobile jacks of the type indicated improved in various particulars to the end that convenience in operation may be promoted, as well as simplicity of construction.

SIGNALING DEVICE.—M J. MANDELBAUM, care of Lucien Stat, 179 Broadway, New York, N Y. This invention provides a signaling device for automobiles and similar vehicles, and arranged to permit the chauffeur to display warning signals during the day and night to following vehicles whenever it is desired to stop the vehicle or to turn from a straight course to the right or to the left.

ATTACHING AND CONCEALING MEANS FOR VEHICLE CURTAINS.—Broadly, the invention comprehends the provision of pockets along the edges of the top adjacent to which the curtains are attached and designed to be folded or otherwise compactly arranged to be retained in the pockets in a relatively concealed position but in such manner as to be capable of being readily lowered when they are desired to be used.

WHEEL FOR TRACTION ENGINES.—F R. NYBERG 164 N 8th St., Lamar Colo. The invention provides mechanism in connection with the usual drive wheel, for permitting the mud cleats usually used on the periphery of the wheel to be dispensed with, and wherein the said mechanism is so arranged that it may be brought into and out of operative position whenever desired, and wherein a series of holding dogs is provided, movable radially of the wheel, and operated by a cam, to cause them to protrude at any desired point in the periphery of the wheel, and wherein other mechanism is provided for preventing injury to the machinery or to the wheels or dogs from solid bodies in the road.

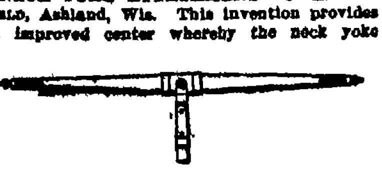
HEADLIGHTS FOR VEHICLES.—FRANKLIN P SACKETT, 177 George St., Providence, R. I. The invention produces a headlight for automobiles, trolley cars and other vehicles from which the upwardly projecting rays are



HEADLIGHTS FOR VEHICLES.

removed. It produces a reflector for the head lamps in which the sector of the reflector adapted to project the rays from the burner upwardly and toward the side on which another vehicle will approach traveling in the opposite direction is made blank or of non reflective surface.

NECK YOKE ATTACHMENT.—C E. REDFIELD, Ashland, Wis. This invention provides an improved center whereby the neck yoke



NECK YOKE ATTACHMENT

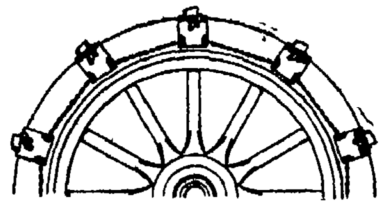
may be positioned in advance of the vehicle tongue, in order that the reins may not become entangled or engaged under the end of the tongue. It provides a neck yoke attachment in the form of a strong connection between the yoke and the vehicle tongue, this connection adapted to allow movement of the yoke incident to the movement of the draft animals.

GREASE-GUN.—H. M DAVIS, 123 Lake St., Yonkers, N. Y. The invention provides a gun adapted to be inserted between two leaves of leaf springs after they have been separated by means of a tool and from which the lubricant may be forced in desired quantity and at desired points by one hand of the operator, provides a special tip for use which insures the delivery of ribbons of lubricant of uniform thickness, whereby a thin film of the lubricant is deposited upon one or both of the [illegible] and provides means for [illegible] the gun with lubricant.

[illegible]—H. P. [illegible], [illegible]. This invention relates to a grip [illegible] the [illegible] handle bar so as to rotate its position by the spring-ing action of the coil at one end, the opposite end being designed to project beyond the handle bar and form the shock absorbing grip.

VEHICLE WHEEL TIRE.—F. V. UNSER, 86th St., and First Ave., New York, N Y. This invention provides a collapsible wearing shoe having adhesive properties with means for expanding said shoe to, and for maintaining the same in, service form; provides a collapsible tire and spreader therefor adapted for employment in connection with a demountable tire rim; and provides a tire relatively immune from such accidents as impair the service condition thereof

TIRE CHAIN.—L. W CLARKA, Garden Valley, Idaho. This invention provides a device capable of being attached to any construction of pneumatic tire or detached therefrom, wherein a series of gripping devices is provided, each in the form of an arc-shaped plate or chip having spurs or lugs on its convex face and adapted to be arranged trans-



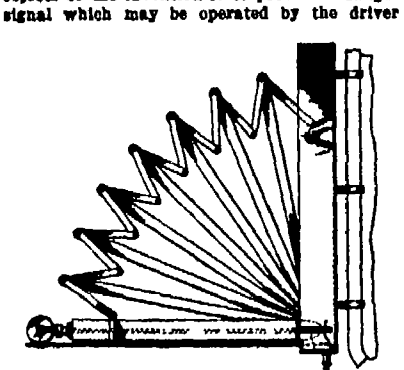
TIRE CHAIN

versely of the tread of the tire, the said plates being connected together by flexible members on opposite sides of the tire, and wherein mechanism is provided in connection with the flexible members for permitting the device to be placed on the tire or removed therefrom.

MOTOR TRUCK.—C T ELDREDGE, Stockton, Cal. This invention supplants the conventional front wheels by one wheel so arranged as to be capable of a relatively great degree of vertical movement with respect to the frame, whereby the jolting now common in such vehicles is very materially lessened, thus resulting in easier riding qualities, less destructive effect on the motor and freight, permits the use of metal tires with the consequent saving prevents torsional strains on the frame, and permits the use of larger wheels with metal tires which adapt the vehicle to rough, mountainous, and stony roads.

KILN CAR.—C E EVANS, Weed, Cal This invention provides a car having a main frame and an auxiliary frame movable relatively thereto, on which the lumber or other material is disposed, a bed and a stake of the auxiliary frame connected by links with a bed and a stake on the main frame so that when the auxiliary frame moves down under the weight of lumber or other material and relatively to the main frame, the links will move the auxiliary frame to press the lumber or other material between the stake on the auxiliary frame and another stake on the main frame

SIGNAL FOR AUTOMOBILES.—H. ROSE care of Henry Rose Merchant and Manufacturing Co, Shreveport, La. One of the principal objects of the invention is to provide a danger signal which may be operated by the driver



SIGNAL FOR AUTOMOBILES

and which may be seen equally from the front or from the rear of the vehicle to which it is attached, the signal being so constructed as to provide for the ringing of a bell in the day time and the illumination of a light at night time, so as to notify drivers of following and approaching vehicles of an intended turn or stop

Designs

DESIGN FOR A RADIATOR MASK.—D. MORA LIVINGSTON, 159 E 38th St, New York, N Y This ornamental design is shown in two figures. The first is a front perspective view of a radiator mask embodying the new design, and the second is a perspective view taken at the side.

DESIGN FOR AN AUTO PEDAL PAD.—J WINKLER, 794 7th Ave., Brooklyn, New York, N Y In this ornamental design the pad is shown in two figures. The first is a plan view of the pedal pad; and the second is a side view.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Making of X-Ray Tubes in War Time

(Concluded from page 96)

the tube which prolongs it, following which the metal faces are polished. This member is then sealed in the end of a glass tube in which air is exhausted in order to determine if there exist inter stices in the solder or if the union between the glass and platinum is an im perfect one After a test lasting about three days, the piece is placed in a stock room where it remains for a certain period before use.

The metallic pieces or electrodes, finished and tested, pass to the glass blowers who work the glass into a ball provided with a neck, which ultimately becomes the neck of the cathode According to the type which the finished tube is to represent, the worker places a number of projections on the bulb—one for holding the anode, one for the anti-cathode and one for the regulator, for instance. This work is obviously of a most delicate character and requires blowers possessing a high degree of skill. The last step in this phase of the work is the placing of the metallic pieces in their proper positions, followed by the melting of the glass around them so as to seal them in place The tube is then exhausted and left in that condition for several days to determine whether there are variations in the vacuum due to faulty sealing

After the bulbs have passed the test just mentioned, they are sent to another department to be permanently exhausted to the required degree Connection with a bulb and the pump is usually made by a prolongation of the regulator chamber Aside from the pumps for exhausting the air from the X-ray tubes, this department of the factory contains apparatus for the production of electric currents of high potential, a switchboard and instruments for electrical measurements.

After the first few minutes of pumping, the tube is connected with a source of electricity The current in traversing the bulb heats the metal members, causing them to release the gas which they contain. The gas is absorbed by the pump When the bulb reaches the high state of exhaustion desired, the pump is shut off from the bulb, but not disconnected, while tests are made to determine whether, despite the severe electric treatment, there is still an excessive quantity of gas which has not been disengaged from the metallic members. After these tests the tube is permanently sealed by the application of heat to the neck through which the exhaustion was effected

It is interesting to note the means of protection employed in the pumping room for insuring the employes against X ray burns. Each testing post is surrounded by a wooden screen covered with a thin sheeting of lead The screen is provided with windows of three-ply glass through which the rays cannot pass, although the operator can readily see the operation of the tube under test through them All controlling apparatus is placed outside the screen where it can be manipulated by the workers without exposing themselves to the rays

From the pumping room the tubes pass on to the first laboratory where they are tested in order to determine whether their action is normal They are then placed in the hands of a woman worker who fits on the radiator member, cements the caps in place, solders certain exterior metal parts together and performs other operations necessary to complete the X-ray bulbs Although now completed, the bulbs are still retained in the factory for another eight or ten days during which they are subjected to a series of exhaustive experiments in different laboratories. Then, and only then, are the X ray tubes shipped out.

In the short space of 18 months, France has not only built up an X ray tube industry which supplies all the needs of her army, but in addition to this she is in a position to furnish X ray apparatus to her allies Furthermore, despite the large needs of the fighting forces, it has been found possible also to provide the health officials and public and private hospitals with these all important tubes.

NEW BOOKS, ETC.

Rubber Machinery. By Henry C. Pearson, Editor of *The India Rubber World* New York *The India Rubber World*, 1915 8vo., 419 pp., illustrated. Price, $6.00 net.

Mr Pearson has made numerous helpful contributions to the literature of rubber, most of them dealing with the material in its growing or crude state In this, his latest work, he shows us the various machines used in fashioning the crude rubber into the finished fabric or device sold to the ultimate consumer The equipment by which such processes as washing, drying mixing calendering and vulcanizing are accomplished is shown by means of cuts which carry with them descriptions sufficiently detailed to make each part and its action clearly discernible There are also sections dealing with cement and solution machinery extraction and reclamation processes, and rubber laboratory equipment The value of the work to the manufacturer is apparent and, since rubber processes are still very imperfect from a mechanical point of view, the inventor also should profit by a close study of the volume.

Practical Surveying For Surveyors' Assistants, Vocational, and High Schools. By Ernest McCullough, C E New York D Van Nostrand Company, 1915 8vo, 401 pp, 229 illustrations Price, $2 net.

In one respect at least the author's exposition differs from the usual text book on this much handled subject instead of assuming on the part of the student a knowledge of algebra, geometry and trigonometry, he meets the needs of those whose knowledge is confined to grade school arithmetic An appendix gives an excellent summary of the essentials of algebra, while the necessary trigonometry is incorporated in the body of the work The text may be used to advantage in schools and evening classes, and it lends itself admirably to the use of the self taught surveyor's assistant who has the ambition of becoming a full fledged surveyor

Practical Forging and Art Smithing By Thomas F Googerty Milwaukee, Wis. The Bruce Publishing Company, 1915 8vo, 146 pp., illustrated

A most attractive and helpful handbook is here given us by a master craftsman who adds to his manual attainments a practical knowledge of teaching His experience is conveyed to the student in a graded series of lessons, in which the points of the art are set forth in exact statement and unstinted illustration This text should do much toward introducing good forging practice into the school shop, and teachers and workers alike must appreciate the beauty and utility of the many designs it presents

Laboratory Manual. Arranged to Accompany "A Course in General Chemistry" By William McPherson and William Edwards Henderson, Professors of Chemistry, Ohio State University New York Ginn and Company, 1915. 8vo., 141 pp., illustrated. Price, 60 cents.

This outline, designed to supplement the authors 'A Course in General Chemistry,' has long been used in their own laboratories. It meets the requirements of the average time devoted to such work in college classes, calls for no unusual apparatus, and is so arranged that certain of the quantitative experiments may be omitted by the beginner, while the simpler tests intended for those taking an elementary course may be passed over by the student who has already had the advantages of elementary instruction

Lessons in Elementary Physiology. By Thomas H Huxley LL.D, F R.S New York The Macmillan Company, 1915 8vo. 604 pp., illustrated.

Huxley's 'Physiology is too well known to need any explanation or commendation. This enlarged and revised edition brings the work into line with the progress made during the last twenty years Such portions of the original work as still hold true and sufficient in the light of modern research are left untouched, but the reviser has shown great skill in introducing present-day knowledge wherever such interpolation is necessary, and the result is the wedding of Huxley's force and clarity of statement to the wider detail and the closer accuracy of our enlarged conceptions.

The Internal Combustion Engine. A Text Book for the Use of Students and Engineers By H E Wimperis, M A., M I E.E New York D Van Nostrand Company 1915 8vo, 319 pp., illustrated. Price, $3 net.

There have been many important developments since the first edition of this book was printed. The increasing usefulness of the internal combustion engine on land was even then a foregone conclusion, but in addition to this growth we have witnessed its rapid adaptation to the requirements of the other elements—sea and air The author has, in the present edition, availed himself of all sources of information dealing with both theory and practice The result is an almost rewritten exposition, covering well the most modern aspects of its subject. As a member of the Gaseous Explosions Committee, appointed by the British Association, the author is exceptionally qualified to set forth the valuable deductions of this body, and a summary of its findings is a part of the present work. Students and engineers will appreciate the many advantages of arrangement and discussion.

Mining and Mine Ventilation. A Practical Handbook of the Physics and Chemistry of Mining and Mine Ventilation. By Joseph J Walsh. New York D Van Nostrand Company, 1915. 8vo., 180 pp., illustrated. Price, $2 net.

In this text the fundamental theories of ventilation receive a more thorough consideration than is usually met with in similar works, and some new material is offered. The book aims, also, at furnishing the student with a more suggestive method of study in a more graphic form. Among new features may be mentioned the manner of determining the size of fan to ventilate a mine under given conditions, and certain facts relating to the water gauge The chapter on mine fires constitutes a commendable addition to the work.

Diversions of a Naturalist By Sir Ray Lankester, K.C B, F.R.S New York The Macmillan Company, 1915 8vo, 424 pp., illustrated Price, $1 75 net.

From time to time Sir Ray Lankester gathers together some of his interesting papers appearing in the *Daily Telegraph* under the title, "Science from an Easy Chair" No one knows better how to make out-of-the-way facts of nature attractive to a wide public. Since, for example, a wide-spread belief once existed to the effect that barnacles hatch out into a particular kind of goose called the 'barnacle goose," the author piques curiosity by a short history of the belief and its reluctant death. Curious old modes of thought and actual facts thus blend to rivet attention and to point his lessons. Courtship among animals always offers an amusing study, and several chapters deal with this subject Birth marks and diet, palmistry and the divining rod, all contribute their quota to the volume, and the author's style is so easy that even the devotee of the detective story should not find it dry reading.

Select Notes on the International Lessons, 1916 By Rev F N Peloubet, D D, and Prof. Amos R. Wells, Litt.D, LL.D Boston W A. Wilde Company 8vo., 376 pp, illustrated. Price $1.

All Sunday School worker's know what the International Lessons are. This handbook is applicable to the work of all grades, and ably seconds the teacher in his work of exposition with hints, illustrations, and explanations of the text. There are ample library references to aid him in any researches he may desire to make, and many subsidiary helps in the form of maps, pictures, quotations, and subjects for discussion. As a study in typography it compels the attention. Rarely have such difficulties in type been overcome in such a masterly manner

The Modern Motor Car. A Book of Simplified Upkeep By Harold P Manly Chicago Laird & Lee, Inc., 1914 12mo, 506 pp., 217 illustrations. Price, $2.50

"The Modern Motor Car" is a very clear exposition of the means to be employed in operating and caring for the automobile so that its efficiency may be maintained for the longest possible time. The construction, care and adjustment of the various parts are plainly set before the student, as are also shop and road side methods of trouble location and repair Hints are given on the wise purchase of supplies. Students, salesmen, drivers and repairers will find here a fund of briefly stated yet adequate information that will help them to get the most out of their business and out of the car

Test Methods for Steam Power Plants. A Reference Book for the Use of Power Station Engineers, Superintendents, and Chemists. By Edward H Tenney, B A., M.E. New York D Van Nostrand Company, 1915 12mo., 224 pp., 85 illustrations. Price, $2.50 net.

These papers convey that knowledge concerning conditions and details of the steam power plant by which alone may true efficiency and economy be attained They give, within the scope of a single volume, a grasp of the situation that will enable the conscientious engineer to keep his costs at the lowest figure. Fuel, furnace arrangement and operation, and boiler cleanliness are factors receiving thorough consideration. The test methods are authoritative, and of two or more methods equally efficient the most simple and speedy one is given the preference. An appendix contains boiler report forms and some valuable tables and equivalents.

Hendricks' Commercial Register of the United States. For Buyers and Sellers. New York: S. E. Hendricks Company, Inc., 1915 1508 pp. Price, $10.

Buyers and sellers will find this twenty fourth edition of Hendricks' Commercial Register as eminently satisfactory as ever, with its lists verified, enlarged and corrected by the latest information obtainable up to the hour of its going to press. Particularly full are the directories of the architectural, contracting, electrical engineering, hardware, mechanical, mill, mining, quarrying, railroad, and iron and steel industries. The compilation includes products from the raw material to the finished article with the concerns, from producer to consumer, that handle them. The scope and the established reliability of the Register make it an extremely valuable book for any firm or individual [illegible] supplies, or table goods.

George Washington: Farmer. Being an Account of His Home Life and Agricultural Activities. By Paul Leland Haworth. Indianapolis: The Bobbs-Merrill Company, 1915. 12mo.; 336 pp.; illustrated. Price, $1.50 net.

Multifarious are the books dealing with George Washington, but we do not remember to have seen one which confines itself to his home life on the farm Most people know that he was born on a plantation, and brought up in the country, but few, perhaps, realize that he had reached manhood before he saw a town of five thousand inhabitants. His ideals were centered, not upon military activities and honors, but upon 'a good Estate on healthy Soil,' and he was withal a man of advanced agricultural views, quick to condemn the careless wasteful methods of the day, and to apply to his own estate a more intensive culture in line with English thoroughness. As a careful surveyor, he was eminently qualified to draw up a map of Mount Vernon, and this is one of the many interesting exhibits of the volume.

Naval Handbook As Bearing on National Defense and the European War By Thomas Drayton Parker, Commander, U. S Navy (Retired). San Francisco John J Newbegin, 1916. 12mo, 80 pp., illustrated. Price, $1 net.

This manual, small as it is, answers almost any question likely to arise in the mind of the layman It describes the various types of fighting ships and the particular part each would play in the event of war The submarine's distinctive features are very ably explained, and guns and ammunition, aircraft, and torpedoes and mines are discussed in brief but intense chapters. The principles of naval warfare are sketched, and such points of international law as are likely to interest Americans at this juncture are skilfully brought out Primed with the information of this little handbook, the reader should be able to do better than hold his own in an argument involving naval facts. Indeed, so far as his friends and acquaintances were concerned, he might easily pose as an authority

The Gasoline Automobile. By George W. Hobbs, B S, and Ben G Elliott, M E New York McGraw-Hill Book Company, 1915 8vo., 260 pp.; illustrated. Price, $2 net.

The more intimate a driver's acquaintance with the mechanism of his car, the more pleasure and satisfaction he will find in it, moreover, there will be a better economy of operation, and the car will maintain a maximum efficiency for a longer time. "The Gasoline Automobile" was prepared in the Extension Division of the University of Wisconsin, and it extends a strong, helping hand to every man interested in the motor car, whether from the point of view of business or of pleasure all types are included, and the excellent drawings make clear almost at a glance the salient points of construction and operation.

A Text-Book of Geology For Use in Universities, Colleges, Schools of Science, etc., and for the General Reader By Louis V Pirsson and Charles Schuchert. New York John Wiley & Sons, Inc, 1915 8vo, 1051 pp, with maps and illustrations Price, $4 net.

The first section of this work, for which Prof Pirsson is responsible, deals with physical geology, dynamical and structural The author has endeavored to maintain a true balance between cultural values and technical requirements, giving perhaps more weight to structural considerations than is usually done, The second section of the work, by Prof. Schuchert, treats the historical side of the science and carefully brings out its relationship to astronomy, evolution, biology and oceanography, and even to botany and zoology, thus broadening the interest of the study and giving due emphasis to its biological bearings. On the whole the author's selection of material and their skillful presentation of it has resulted in a text that should appeal strongly to those seeking a balanced exposition, and its successful use in the Sheffield Scientific School of Yale University further commends it to teachers whose work is largely among those taking professional courses.

The Printing Art Vol XXV, March, 1915-August, 1915. Cambridge, Mass. The University Press. 4to.; 514 pp.; illustrated.

As everybody knows, *The Printing Art* is a monthly magazine that almost ideally combines the practical and the inspirational—though, by the way, true inspiration is the most practical rejuvenator our old world possesses. In dignified binding, these six issues make a very beautiful book, offering us hints from the expert, pointers on business administration, talks to the plain printer, and sound advice upon printed salesmanship. The reproductions in color of book, magazine and catalogue illustrations are masterpieces in their respective fields, and raise the whole volume to a high plane of artistic appeal. [illegible] advertising.

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Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14014) F B W asks Has a successful internal combustion oil engine ever been made, in which continuous combustion is maintained in an independent combustion chamber under pressure, the air supply and fuel supply of crude petroleum oil being injected continuously the oil going first through an atomizer, the air supply being maintained by an independent compressor and the expanded lot of gases from the combustion chamber led into cylinders and used in the same way that steam is used in the steam engine The above being a substitute for the Diesel principle, enabling one to use crude petroleum oil in an internal combustion engine A So far as we are aware the suggested principle for internal combustion engines has never been applied The nearest approach to it, of which we have seen data, is a German internal combustion turbine In this turbine the combustion takes place in independent radial cylinders, or rather combustion chambers, and the gases under pressure are led against the rotor The combustion takes place in consecutive chambers. Check valves at the outlet of the chambers permit the necessary scavenging of the chambers This scavenging of the cylinders is necessary because combustion cannot be maintained in depleted air In the two cycle Diesel type this scavenging is accomplished by the admission of fresh air at about 12 pound pressure for 8 or 10 deg of the cycle just prior to the admission of a fresh charge of fuel. In the ordinary two cycle type this same end is obtained by means of a baffle-plate on the top of the piston this plate deflects the fuel charge to the top of the cylinder under the pressure obtained by the crank-case compression, and the exhausted charge is forced out by the fresh charge We are at a loss to see how continued combustion may be maintained in a closed cylinder

(14015) C W E. asks Please tell me thru your ' Query " column if the water on the up-stream side of a dam has a buoyant effect upon the structure of the same? A Unless great care is taken to exclude all water from the foundation of a dam, it has a very decided effect on the stability of the structure The ordinary gravity section dam depends entirely upon its weight for resistance against the overturning effect on the head of water against it If there is hydrostatic pressure under the dam, the weight of the dam, in so far as the resistance to overturning is concerned is cut down by an amount equal to the entire upward pressure against its base Within the last few years the 'Ambrusen' type of dam has sprung into use for locations where it is impossible to exclude the water from the foundations, as in sand or gravel This type has a reinforced concrete deck with a flat slope, and the water over this deck adds its weight to that of the concrete in the dam and the resultant pressures are more nearly vertical than in the vertical faced dam This deck is supported by buttresses which have perforated spread footings In this way the area of the base against which the upward pressure is exerted is reduced to a minimum, as any water which may leak under the toe is allowed to run off Failures have occurred in gravity dams where the section was safe against overturning even with the pressure under the base, because of the decrease in the frictional resistance against sliding due to the decreased weight of the dam.

(14016) W W asks Can you give me dimensions to make an electro magnet coil for remagnetising magnetic magneto size of wire to be used on a 110 volt circuit. Must the wire be put on even length of coil and how many turns? What size of lamp to convert in the circuit? How can I tell when magnets are weak and when they are fully charged? Can magnetism be measured? A. You can make an electro-magnet for charging steel magnets by winding a coil of one ohm resistance of double cotton-covered copper wire on an iron core and connecting it in series with a lamp bank of incandescent lamps Of course direct current must be used. The iron core may be a ½ inch soft bar iron bent into U shape, with the wire wound on the bend and around on each arm of the U If you would make a neat job you should make two coils of the wire and have two iron bars about three inches long with a cross piece to which one end of each bar is fastened by a screw The cross piece should be as large as the bars in section. A coil may be made for each bar upon a spool which will slip over the bar with a close fit. To get sufficient current you can use an arc lamp, or a bank of incandescent lamps. Ten 32 candle carbon lamps in multiple will give sufficient current. If you use No. 20 wire 100 feet should be taken. Of No. [illegible] wire [illegible] feet should be used. The magnets are weak when they will not do their

work. A magnet will be charged by the coil described in a short time, a minute or so. You may also test it by its lifting a weight. See what it will lift before and after charging. A magnetising force can be measured.

(14017) E. W asks Can you give me any information through your correspondence column whether there is any scientific basis for the claim that gasoline will explode when strained thru chamois skin? Is the article enclosed perfectly true? Do you think this information worthy of widespread knowledge through your paper? A Gasoline is strained through chamois skin very commonly when it is poured into the tank of an automobile or other gasoline engine The statement that gasoline and chamois skin are a fatal combination is on its face rather open to doubt To test the matter we arranged a delicate electroscope in connection with a gasoline strainer and a metal gauze so as to get an indication if any electricity was generated by the friction of the gasoline against the chamois skin We repeated the experiment several times without getting the slightest indication in the electroscope Moreover, it requires rather a hot spark to ignite gasoline vapor hotter than can be produced by gasoline filtering through chamois skin *There is nothing impossible* about the generation of a small charge of electricity by the friction of one insulator against another but in this case we are not able to detect it We cannot say that we think the *statement of the article which you send is* true certainly the Scare Heading' is not justified by our results.

(14018) G L P asks Suppose that the earth is a perfectly shaped sphere and measures exactly 25 000 miles in circumference at the equator If under these conditions we have a thin steel non stretchable band measuring exactly 25 000 miles in length this if laid around the earth opposite the equator would make all sides of this band touch the earth at all points and the ends of the band would just meet Suppose we elongate this steel band 300 feet so that it measures 25 000 miles 300 feet long and then arrange it so that the ends just meet and that this band forms a true circle and lay it concentrically over the earth's sphere at the equator would not the distance between the earth and band at all points be approximately 48 feet, or in other words, would not this band in this case be about 96 feet larger on its inside diameter than the earth? A You are quite correct in supposing that a band which just fitted a perfect sphere would stand off the sphere about 48 feet if the band were lengthened 300 feet It makes no difference what the size of the sphere is, whether it be the earth or a glass marble We give you the solution for the benefit of your engineering friends. Let C be the circumference of the sphere and x the increase in diameter then $C + 300 = \pi (D + x) = \pi D + \pi x$, but πD is the circumference and therefore $\pi x = 300$ If $\pi = 3.1416$

$x = 96.5$ feet, very nearly

Hence the band stands off 48.25 feet You see the circumference of the sphere does not affect the result

(14019) G W Y asks I am trying to learn to identify some of the stars and groups of stars but am only an inexperienced amateur at the work I have been observing a very brilliant star since August which rises in the east or southeast in nearly the same place as Orion and is seen now at about 10 30 in the evening some distance south of the zenith, as nearly as I can guess. I would like very much to know what it is if you can identify it from my description A The very bright heavenly body about which you inquire is the planet Jupiter It is not a star It is now in the south in the early evening The star Canopus is never visible in our latitudes It is a star of the southern heavens. For learning the stars you need a good star map, although the small maps published each month in the SCIENTIFIC AMERICAN can be of great service in tracing the stars Burrit's Atlas of the Heavens is the plainest for a beginner to use We can supply it for $1 05 postpaid

(14020) D J H asks Is it possible that an object travels faster than the force by which it is being propelled? As in the case of the ice boat, of which our good old sportsmen declare that there and then it went 'faster than the wind A. It is not possible for an object to travel faster than the force" by which it is propelled, but it is the case that the pressure of the wind may move an ice boat faster than the wind is itself moving The wind is not moving in the direction in which the boat is moving, that is, the boat is not sailing before the wind, but at an angle with the direction of the wind and the slight friction of the ice upon the runners enables the boat to go faster than the wind This has often been proved

(14021) M K M asks Will you have the kindness to inform me what substance will produce vapor like smoke by drawing on through it? Sometimes this substance is placed in a tube like a cigar and the end placed in the mouth, draw air through it and puff it out like smoke A. A simple way to produce a smoke-like powder by the chemical action of two gases upon each other is to use ammonia and hydrochloric acid. The combination gives ammonium chloride which is harmless. A drop or two of the acid air blotting paper may be placed in one end of a tube like a cigar, and a drop or two of the ammonia also upon paper may be placed in the other

end of the tube when it is to be smoked Then draw the air in through the tube and blow the smoke out from the lips as in smoking a real cigar These chemicals may be arranged in a brasier, or pan so as to blow air gently up through it and the appearance of a smoking fire can be produced very artistically

(14022) A. M W asks 1 Why was Europe better fitted than Asia to develop the highest civilization? 2 Why not so well fitted as Asia to originate civilization? A. 1 Civilization has developed faster and mounted higher in temperate than in warmer climates. Nineveh and Babylon were near the parallel of thirty north latitude, while the greatest achievements of the human race have been largely made between the parallels of forty and fifty north latitude South of the parallel of thirty little has been achieved A hot climate does not dispose men to exertion and little is won without exertion 2 We are not able to say why Asia was better fitted for the cradle of the human race

(14023) W M C asks My wife has some sterling silver table spoons and has been buying silver polish to clean them One day when she decided to clean them up she put the lot in a new zinc bucket with warm water and a little soap to soak a few moments before cleaning When she went to clean them she found them already clean A second trial did the same thing so we save the silver cream Do we lose the sterling by the operation? Please explain the process A The action in cleaning your silver spoons in the zinc pail with soap is an electrical one A feeble current flows from the zinc to the silver, and since zinc is positive to silver no silver is carried over to the zinc but a minute quantity of zinc may be carried over to the silver In cleaning silver in this way a piece of sheet aluminum and a porcelain or earthen dish are often used The liquid may be either cooking or washing soda in water

(14024) L. G asks Will you kindly state to us the proof of the following Two *bodies, having the same density,* although of different weight, falling from a given height will reach the ground at the same time A Two balls of the same density but of different weights falling through the air from the same height will *not* reach the ground at the same time, except the distance through which they fall be small The heavier will reach the ground first if they fall from any considerable height This is because it has more mass with which to overcome the resistance of the air In a vacuum all bodies light or heavy fall with the same velocity but not in the air They fall in the air against a resistance and if the fall were far enough a body would come to have a constant velocity Light bodies come soon to have a constant velocity, as you have doubtless observed

(14025) D M C asks Will an iron sphere go to the bottom of the ocean, no matter what the depth? Naturally it would if the density of the water remained the same but the point has come up that its density increases with the depth due to the settling of the salts and alkalines I have always understood that in what is called a mechanical mixture settling will take place But in the case of salt water which is called a chemical mixture is it not? there will be no settling therefore no change of density and therefore the sphere will go to the bottom A An iron sphere will sink to the bottom in any depth of the ocean yet discovered The deepest Deep thus far found is the Nero Deep where the bottom was found at a depth of 31 614 feet Since the density of iron is about 7 75 it does not seem possible that water should ever become as dense as iron by any amount of compression It could not be made so dense by dissolving the known salts in it The salinity of sea water is on the average, 35 parts in 1 000 by weight In general the salinity of the ocean water is greatest at the surface because of the effect of evaporation which is to increase the salinity There is no settling of salts in the ocean All the salts found in sea water are soluble in water and so form what you call a chemical mixture but may better be termed a solution It does not differ from a solution of sugar or common salt in water You will find the subject fully discussed in Sir John Murray's recent book The Depths of the Ocean, which we furnish for $7 50.

(14026) G J C asks There has been some discussion about photographs taken of automobiles going at the rate of fifty or sixty miles per hour In some cases the top of the wheel appears transparent while the bottom of the wheel is clear Some say that the top of the wheel goes faster than the bottom others say that it is due to optical illusion which deceives the eye also the camera Would you and could you explain this and oblige A It is quite true that the top of a wheel on a rapidly moving vehicle is moving forward faster than the point of the wheel which is in contact with the ground, if this motion is referred to the ground The point of the wheel which is in contact with the ground is not moving forward at all as referred to the ground on which it rests, unless it is slipping The part of the wheel which is at the top will in a moment be in front and then it will move down to the ground and up on the rear side of the hub to the top again. You can see that this motion is a complicated one If you stand by the side of a moving vehicle you can see that the point of the wheel which rests on the ground is not moving forward over the ground,

but is at rest on the ground until it begins to rise into the air again. This will explain why the top of the wheel looks transparent. The spokes go by so fast that the eye gets a continuous view through them because of the persistence of vision.

(14027) J H G asks· Would a substance that would sink to the bottom in ten feet of water sink clean to the bottom in five miles of water all pressure notwithstanding, and if the same is true of a great ship? A A substance which is considerably heavier than water will sink to the bottom in the ocean. An iron ship filled with water, will certainly go to the bottom A substance which is only a very little heavier than water might float at a determined depth A submarine does this. The air and the water ballast in it are so adjusted as to provide for its floatation at a determined depth

(14028) H A. S asks 1 A vessel of boiling water may be removed from the stove while boiling, and set up on the palm of the hand, and retained without discomfort so long as the water continues to boil Where does the cold come from to cool the metal bottom of the vessel while boiling? 2, A cat may be suspended by the legs in the air, a few inches from the floor (say six inches), and when released, in this short space, will turn over and strike on her feet. Where does she find the leverage to shift the center of gravity, so as to turn her body over in the short space? A, 1 The explanation of the fact that a kettle of boiling water may be placed on the palm of the hand without discomfort is this The heat necessary to keep the water boiling comes from the iron of the kettle and thus the iron is cooled, so long as the water boils. The sensation of cold arises from the taking of heat out of the hand by the iron It is a good conductor of heat and so gives its heat to boil the water and becomes cooler to the hand When the water no longer boils then the iron becomes too hot for the hand to endure it 2 The turning of a cat in midair has been a puzzle to scientific men Pictures of its falling were made by the National Academy of France by cameras before the days of the moving picture camera, which showed the cat in different positions during its fall These showed wide changes in the position of its body especially in the humping of its back the movement of head and legs and the switching of its tail All these actions doubtless produce the rotation The remarkable feature of it all is the wonderful rapidity with which the mind of the animal must work to direct these motions.

(14029) S J L asks Can an electrolytic interrupter be employed satisfactorily in connection with a rotary gap? A No, a rotary gap will not give satisfactory results when employed in conjunction with an electrolytic interrupter for the reason that the latter does not operate steadily enough It is far better practice to employ a mechanical interrupter and mount the rotary spark gap disk on the same shaft, so that the interruptions of the circuit and the sparks will be in synchronism An electrolytic interrupter when used in conjunction with an ordinary spark gap will give fair results where the amount of power employed is not in excess of ½ kw or even possibly 1 kw

(14030) M E. P asks I am a regular reader of your paper Would you kindly answer the following question? Prefer answer by return mail What effect will the burned gases from a gasoline engine have on rubber, that is, when the gas is cooled and cleaned? Will the gases cause the rubber to deteriorate, or will they tend to preserve? A The gases from combustion do not seem to have any marked effect upon rubber Rubber tubing is extensively used for carrying gases and seems to last a long time.

(14031) H G V A asks It takes the sun's rays or light eight (8) minutes (approx) to travel from the sun to the earth's surface. 'A' contends that, in view of this fact, the sun has *actually* arisen' eight minutes before we are aware of it, and has "set' eight minutes before 'B' contends that, as sunrise and sunset are purely local phenomena, we are aware of its doing so at practically the same instant it appears or disappears, the only time interval elapsing being that which the sun's light requires to reach the observer from the *horizon* A. The time given in the almanacs for sunrise and sunset is the time when the upper edge of the sun, as corrected for refraction is in contact with the sensible horizon of the place This means that the first ray of the rising and the last ray of the setting sun marks the moment of sunrise and sunset. These rays leave the sun 8 minutes and 19 seconds before they reach the eye, hence the upper edge of the disc of the sun is actually 8 minutes and 19 seconds below the horizon, where it is seen to set at any place.

(14032) H P G asks "A" claims that if all the compartments of an iron steamship were filled with water, the ship would still float "B" claims that it will sink under circumstances above mentioned. Which is right? A If an iron steamship were filled with water it would sink rapidly to the bottom in any part of the ocean The "Titanic" and the "Lusitania" went down with a plunge, and doubtless they were not completely filled with water until they had sunk far enough so that the pressure of the water burst in the closed compartments. The "F-4" sank and was raised again from a depth of 300 feet at Honolulu.

THE BEST REASON IN THE WORLD FOR BUYING A CADILLAC IS WHAT EVERYONE THINKS, AND SAYS, AND <u>KNOWS</u> ABOUT THE CADILLAC

New-York Life Insurance Co.

346 & 348 Broadway, New York City.

SEVENTY-FIRST ANNUAL REPORT

To the Policy-holders and Public

One year ago I stated that the European war would not have any material effect on our Company, notwithstanding the world wide character of its business

I now confirm that statement by facts based on experience that includes twelve added months of war.

In life insurance the financial effect of mortality is expressed by the per cent which the total actual death losses of the year bear to the expected death losses according to the tables of mortality adopted by the state for valuation purposes Through a period of years this per cent (disregarding fractions) has been as follows:—

1912 Actual death losses 76% of the "expected"
1913 Actual death losses 73% of the "expected"
1914 Actual death losses 73% of the "expected" (5 months of war)
1915 Actual death losses 73% of the "expected" (12 months of war)

In all the world from the beginning of hostilities up to January, 1916, seventeen months, we had in all the membership of the Company 534 separate war claims

During the year 1915 —

409 members of the Company were killed in war
448 members of the Company were killed by accident
707 members of the Company died of cancer
772 members of the Company died of pneumonia
950 members of the Company died of tuberculosis

In the grim battle of life with its inevitable mortality and its unnecessary slaughter the mortality of a world-war, even while it is being prosecuted amongst a membership that is also world-wide, is about—

91% of that caused by accident in the same membership
58% of that caused by cancer in the same membership
53% of that caused by pneumonia in the same membership
43% of that caused by tuberculosis in the same membership

A modern war cannot be localized Electricity, steam and the partial conquest of the air, have made the world so small that any great international upheaval shocks the whole of civilization War under such conditions takes its toll impartially and in these days the nation which is an innocent bystander suffers proportionately with the belligerents

It is interesting to notice that this Company had in seventeen months war losses from seventeen countries, and that what may be called AMERICAN LOSSES exceed those of any belligerent country except in two instances:

United States (including Lusitania losses)	$112,000
Australia	29 000
Austria Hungary	105,500
Belgium	23 000
Canada	49 000
Great Britain	84 000
Russia	76,000

Only in France and Germany have the totals exceeded those of our own country.

Life insurance isn't designed merely for times of peace It would confess its inability highly to serve humanity if it did not measurably cover all the risk naturally incurred by healthy men

DURING THE YEAR 1915 NO POLICY HOLDER OR BENEFICIARY, WHEREVER RESIDENT, WAS DENIED A REASONABLY PROMPT SETTLEMENT OF ANY JUST CLAIM WE HAVE IGNORED AND STILL IGNORE ALL MORATORIA, ALTHOUGH THESE REGULATIONS ARE INVOKED AGAINST US IN SOME PLACES

In New Business we have done well We have made good the natural shrinkage on an outstanding business of $2 347 000 000 at the close of 1914 and increased the total amount to $2 403 000 000 at the close of 1915

Of the $214 000 000 new business paid for in 1915 over $200 000 000 was secured in the United States and Canada

NO BOND ISSUED BY ANY BELLIGERENT COUNTRY AND HELD BY US WAS IN DEFAULT OF PRINCIPAL OR OF INTEREST AT THE CLOSE OF 1915

Market values as a whole are a little lower than a year ago Bonds of belligerent nations are quoted in our Annual Statement at the market where a quotation was obtainable otherwise and in only one instance as of June 30, 1914

THE INVESTMENTS OF THE YEAR (OUTSIDE OF LOANS ON POLICIES AND REAL ESTATE ACQUIRED THROUGH FORECLOSURE) WERE $36,696,191 59

INVESTED TO PAY 5 13%

As follows

Railroad Bonds		6 829,045 94
	INVESTED TO PAY 4 69%	
Foreign State and Municipal Bonds		10 060,612 78
	INVESTED TO PAY 5.27%	
Provincial City County School District and Township Bonds in the United States and Canada		7,567,624.66
	INVESTED TO PAY 4 73%	
Miscellaneous		166,488.52
	INVESTED TO PAY 4 84%	
Bond and Mortgage		
Farm Loans		7,492,487.89
	INVESTED TO PAY 5.63%	
Loans on other Real Estate		4,377,936.30
	INVESTED TO PAY 5.29%	

ANALYSIS AND EARNING POWER OF LEDGER ASSETS, DECEMBER 31, 1915

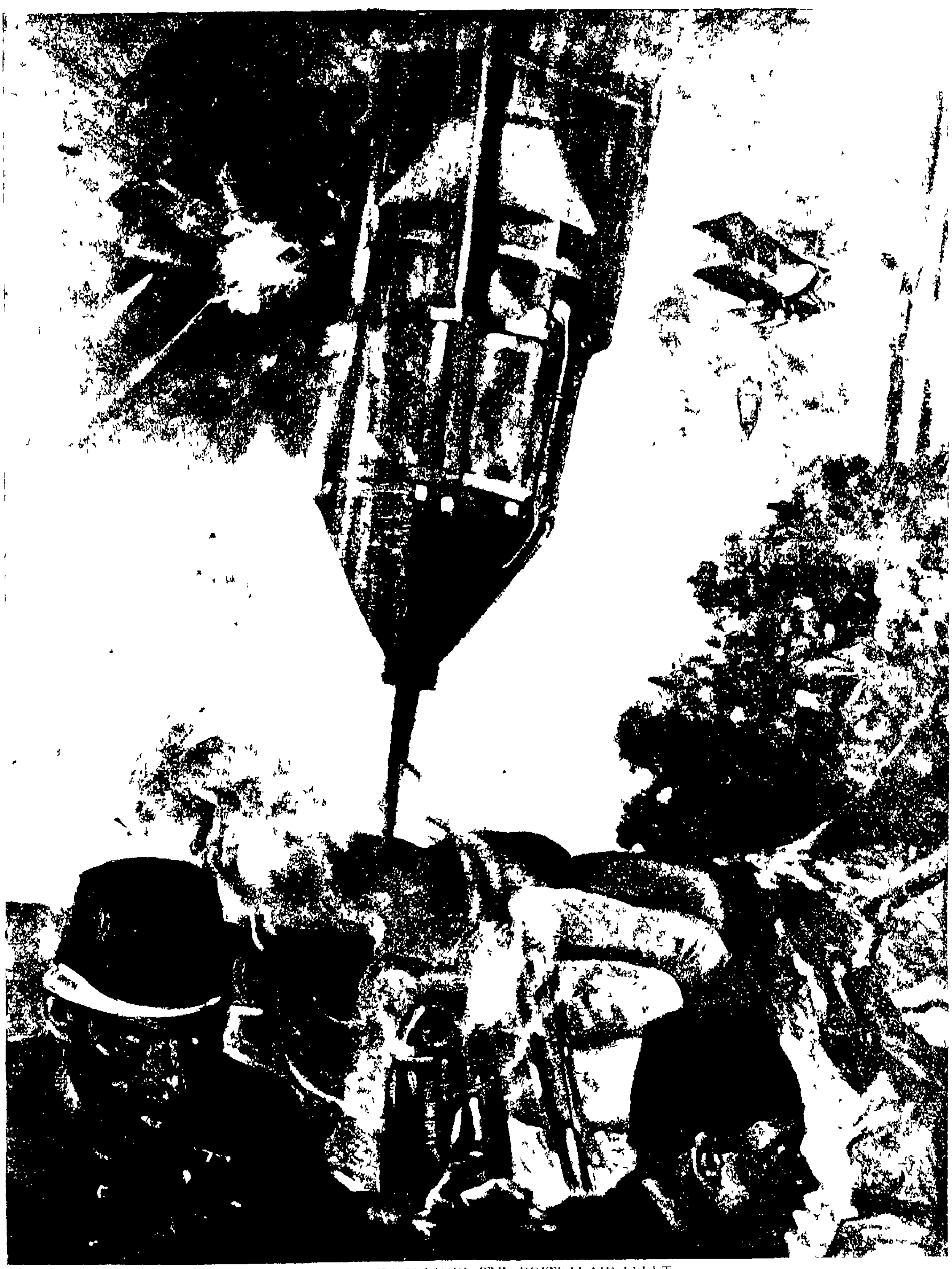
Railroad Bonds (4 21%)	$216 948 129 94
Foreign Government and Municipal Bonds (4 22%)	97 877 166.38
Policy Loans (5% +)	156,987,817.23
Premium Notes 5%+)	[illegible]
Mortgage Loans	
On Farms 5 62%)	11 [illegible]
On Other Real Estate (4 96%)	147 [illegible]
State and Municipal Bonds (4 21%)	63,[illegible]
Stocks (Received from Reorganizations) (8 99%)	296,871.[illegible]
Real Estate Owned (3 70%)	12 171,[illegible]
Collateral Loans 6%	[illegible]
Miscellaneous Bonds 4 68%)	5,161,[illegible]
Cash (2 58%)	20,[illegible]
Total	[illegible]

Assets (market values) Dec 31 1915	$822,[illegible]
Legal Liabilities Dec 31 1915	[illegible]
Reserved (market values) for Dividends and Contingencies, Dec. 31, 1915	[illegible]
Income 1915	[illegible]
Paid Policy-holders in 1915	[illegible]

January 13, 1916

DARWIN P. [illegible]

SCIENTIFIC AMERICAN



GIANT BOMBS USED BY THE BRITISH AIR FLEET

Vol. CXIV No. 5
January 29, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
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SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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Taking Salt from the Sea with Modern Methods

By Paul H. Dowling

IT seems a long way and a great transformation from the ocean water of San Francisco Bay to the contents of the salt shaker on your dining room table yet the process is not so remarkable when you consider that it all takes place right at the shore of the ocean, beginning with the filling of the ponds at the edge of a bay, with water and ending half a mile away with the shipment of minute crystals of shaker salt from the refinery

During the past ten years the progress made in the American salt industry has been great. In April, 1905, salt making on San Francisco Bay was described in an article by Enos Brown in the SCIENTIFIC AMERICAN At that time water was brought from the bay into the ponds at the rise of the tide by grotesque-looking Chinese windmills, and the crystallized salt was wheeled into the refinery in wheelbarrows. To-day, in marked contrast, gasoline engines pump the sea water into the ponds and gasoline locomotives draw long trains of specially constructed cars out over the hard beds, along the dikes and up to huge piles of the product lying beside the refinery

The gasoline locomotives employed in the salt works to haul the salt trains from the beds to the heaps are interesting in themselves. Hardly larger than the toy trains that haul small cars around a summer resort track, their gasoline motors possess considerable power, in fact the locomotives can readily draw a dozen or more heavy cars to the dump Here a bucket lift takes the crystallized deposit to the top of the heap where a horizontal screw passes it on out to the proper place on the piles About 25,000 tons of salt is represented in the large heaps appearing in one of the accompanying illustrations

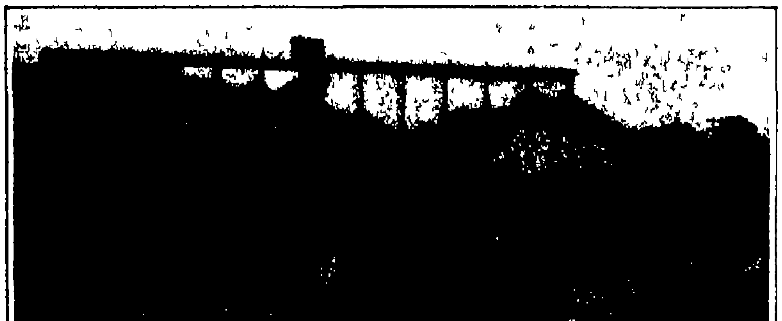
The plant at Leslie, just south of San Francisco on the peninsula, while a representative one from the standpoint of methods employed, is only one of a great many on the Pacific coast. There are a dozen or more across the bay and several farther south, at San Diego Conditions seem to be almost ideal, however, near San Francisco, for humidity and temperature at that location are highly favorable to evaporation.

The sea water is usually brought into the ponds nearest the bay in the spring and winter and then allowed to saturate gradually until the following season As the brine reaches a certain density, it is transferred through canals and trenches into the next basin up the line toward the refinery When it reaches 75 to 80 deg., the brine is transferred to the settling basins and becomes a saturated solution It then goes to the salting ponds where the salt is deposited and the water remaining allowed to run off into the ditches. Thus a continual process is going on the water running through the various ponds until it finally reaches the salting pond The water starts to make salt only after it has reached a percentage of 105 or 106. While water is being taken in at the first ponds, the water which was taken in some months before is going through the final stages of super saturation

In the ponds where the salt has finally become crystallized, there is a soft, black ooze beneath, and one's feet sink into the mass much in the same manner as they would sink into slush covering a pond of ice. The crust which has formed on top is somewhat like a hard crust of snow formed by rain and freezing, and in some places is as hard as ice itself. The salting ponds which have become solidified in this way have an appearance comparable to a skating rink which has become covered with snow or a rough layer of ice.

The tracks for the small trains are merely laid down on long boards which can be moved from place to place over the salt beds as the workmen shovel the salt from the ponds While one train of cars is being loaded at one side of the pond the two small engines are hauling another train from a second track down to the heaps

The transformation from pure ocean water to the heavier solutions is shown in the color of various ponds In the outer basins the water is as clear as that of the bay and sea gulls and ducks swim around as if on the bay itself Farther in in the settling ponds, the water takes on a yellow color which becomes still deeper in the super-saturated solutions In the salting ponds the water appears almost coal black under the white crystals which have formed above it.



Heaps of salt aggregating 25,000 tons, lying beside the refinery at one of the California salt works

Loading salt into cars for transportation from the salting ponds to the heaps beside the refinery

Removing the salt from the cars and transporting it to the top of the heap by a bucket hoist

Apparent Death in the Realm of Microbes

By Our Berlin Correspondent

IF the conditions of life of a given organism are impaired to the extent of interfering with the most necessary vital processes, the organism, in most cases, will die Some few organisms, however, are capable of passing into a condition of apparent death or *anabiosis* in which no sign of life can be recognized even with the most refined means of observation

In an article recently published in a German daily (see *Vossische Zeitung* September 19th) Adolf Koelsch discusses some remarkable experiments made by I Schultz and A Singol of Petrograd which would seem to solve in part at least the much debated question as to whether the mechanism of life in the state of anabiosis, is actually arrested or if there are traces left of certain vital functions.

The experimenters dried roundworms out so thoroughly as to make them flat as paper strips and after soaking them in water allowed them to wither once more The dried-out worms in order to ascertain the condition of their inner organs were then cut into thin slices. Though all the liquid had been evaporated, the tissues were found to be capable of swelling again all parts immediately assuming a quite normal condition as though the animalcule 'had been snatched out of the midst of life, being capable of continuing its existence at a minute's notice '

The water thus had actually disappeared from the organs In order to ascertain how matters stood with respiration the exchange of oxygen between the dried out mass and its surroundings the experimenters locked some dried-out threadworms, rotifers and other microbes, which for eight months had been kept in the state of anabiosis, in an air tight box, in which all traces of atmospheric oxygen were replaced continually by an uninterrupted flow of purified hydrogen allowed to pass over the animalcules during a fortnight Everything was thus done to isolate the microbes from any contact with oxygen After a fortnight, the would be corpses, on being moistened with water were found not only to resuscitate but to resuscitate more readily and more rapidly than those not treated with hydrogen Hydrogen mummies would be restored to life after fifteen minutes whereas others took forty minutes All however were quite healthy and all experiments invariably led to the same results

How is this puzzle to be interpreted? Details of the process will have to be ascertained by chemists suffice it to say that, as proved by these experiments it is by no means immaterial for the dried-out living substance whether it is kept in an atmosphere of oxygen or hydrogen nor is it immaterial whether it is kept in the state of anabiosis for some length of time or only temporarily Both facts, however are hardly compatible with the supposition that every trace of vital functions is actually extinct in the state of rest on the contrary the variation in the time of resuscitation shows that in the dried out cellular system during the period of apparently complete rest, there are ceaseless changes going on

This shows that animals in a state of anabiosis can not well be likened to engines temporarily stopped by cutting off the supply of fuel and life thus asserts its superiority over any purely mechanical systems While an engine requires the same amount of energy to be set working irrespective of the length of its period of standstill—provided it has remained unaltered—those animals are revived with the more difficulty as they have been longer at rest

The experiments referred to are of great interest not only for their immediate value but also for the additional knowledge they furnish on the subject of death, of which so little is known even at the present day

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Preparedness and Our Merchant Marine

NO matter how the problem of our merchant marine is viewed, no matter from what angle it is approached, only one solution can be reached. It must be built up now, as it was built up in the beginning with substantial government aid. Washington, Adams, Jefferson, Madison all fostered the infant shipping industry of this country by preferential duty. Then later, when Great Britain came to the rescue of its shipping with a subsidy, this move was promptly met, and under a Democratic President, too, with the payment of an equal and even greater subsidy to American vessels and our ships continued to maintain their enviable premier position in the handling of the world's commerce.

Not until the intersectional political strife between the North and South cut down these subsidies did our merchant marine begin to decline and British shipping to gain the ascendancy. This was in 1855, six years before the outbreak of the Civil War. It was not the war, but our desertion of American shipping interests, while it was struggling in competition with foreign subsidized vessels that swept the Stars and Stripes off the seas. This is a point in history which does not seem to be appreciated by the public at large. It is brought out very clearly in a paper on "The American Merchant Marine: What It has Been, What It Is, What It Ought to Be," that has just been published by the Boston Chamber of Commerce. This paper is republished in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT because it is one of the most lucid expositions we have seen of the cause of the rise and fall of our merchant marine. The paper shows very clearly that some form of well regulated subsidy is absolutely essential to the upbuilding of American shipping.

Unfortunately the idea of a subsidy is particularly repugnant to certain sections of the country. We can tolerate a tariff which is just as truly a subsidy, although it may not be so readily apparent that the revenues are collected out of the pockets of the general public, but whenever the word "subsidy" is mentioned we picture our Government officials reaching into the pockets of the public for money to pay a few privileged individuals. Why should the public be concerned with the nationality of the boats that carry our commerce? Why should we draw large sums from the national funds merely to have our flag wave over the seas? These are questions that are asked by individuals who are not broad minded enough to realize that every flourishing industry and every prosperous commercial development is bound to react upon the general prosperity of the nation.

However laying aside this argument, it should be sufficiently clear to every one in these trying days that the merchant marine is a *national necessity*. This is a lesson that has been rudely and painfully administered us by the present war. The Spanish War should have taught us the need of a large auxiliary fleet. The recent expedition to Vera Cruz pointed out that necessity. Now however we learn that not only in war but even in time of peace we are sadly in need of ships which cannot be bought at any price, while the principal European nations are at war. A subsidy therefore is not to be viewed merely in the light of protection to our shipbuilding plants and shipping companies, it is rather the price that must be paid by our people for a most important adjunct to our navy for service in time of war and for the security and independence of our trade while other nations are at war.

In order to build up our merchant marine we need a campaign of education. In the case of an invalid the physician must have a complete record of the history of the case before he can prescribe intelligently to the needs of the patient. Our people must have a better comprehension of the needs of our merchant marine before Congress will be likely to pass laws that will lighten the burden of the past and change the condition of sea service so that this trade will become sufficiently profitable to induce capital to invest in an industry which our continental position and immense littoral and our great foreign commerce entitle us to.

The paper, which will be published in the SUPPLEMENT of January 29th and February 5th, is recommended to every one who would be informed on this problem of vital national interest. Indeed, it is the duty of every American citizen to acquaint himself with the situation before us and how it has come about.

The Peril of the Submarine

IN the submarine modern warfare has reached a climax of frightfulness. Not only is the submarine frightful in the destruction it metes out to the enemy, but in the horrible death it is ever ready to hurl at its own crew if, for a moment, they should relax their vigilance. It has increased the difficulties of navigation tenfold by the addition of a third dimension to its direction of travel. Stone blind in pitch black darkness it must be guided through the depths of the sea, liable at any moment to be crushed against an uncharted rock or to bury its nose in a bank of mud from which it cannot be worked free.

But as if these perils were not enough the submarine carries within its tight little hold stores of pent-up energy ready to be discharged at the slightest provocation. Death lurks in the warheads of the torpedoes any one of which is powerful enough to shatter a dreadnought and send it plunging to the bottom. Danger lies in the reservoirs of highly compressed air that are indispensable to the navigation of the boat, in the liquid fuel used to drive the engines when the vessel is on the surface, in the electric batteries that turn the motors when the boat is submerged. These last may seem the safest of the lot, but it is impossible to store energy without danger. Hydrogen is generated when the batteries are charging and discharging. The charging is done when the boat is on the surface and it is comparatively easy to get rid of the gases, but when the battery is giving out its energy to the motors and driving the vessel under the sea all the hatches must be closed and it is impracticable to discharge the gases out of the boat. A ventilating system must be used to carry them away from the batteries and dissipate them throughout the hold of the vessel. A still further danger of the battery is the possibility of letting salt water come into contact with the electrolyte, which would result in the generation of chlorine gas and the poisoning of the crew.

It was with the purpose of eliminating this last danger that experiments were made with the new type of battery. The nickel iron Edison cell uses an electrolyte consisting of caustic potash, or lye. No dangerous reaction takes place when salt water comes into contact with this electrolyte. However, this danger is already practically non existent even in lead batteries, because as they are now constructed there is absolutely no danger of leakage and not until the hold of the vessel is filled with water to a level of several inches above the top of the big batteries is there any possibility of forcing salt water into them. When a submarine has reached as serious a condition as this the chances of the crew are decidedly hopeless even though they be not exposed to the danger of poisonous gases.

While intending to eliminate one danger however, the nickel iron battery has intensified another danger. Fully twice as much hydrogen is given off by the Edison battery as by the standard lead battery which is practically universally used. Furthermore, as the carbonic gas in the air has an injurious effect upon the caustic electrolyte the individual cells of the battery are not properly ventilated. This results in the formation of an explosive mixture of hydrogen and oxygen gases which is always confined in the cells.

The explosion in the F 2 the other day was undoubtedly due to the large volumes of hydrogen given off by the Edison battery while it was being subjected to tests. Such was the finding of the Board of Investigation. At present writing the Board of Inquiry is *still continuing its hearings and has not yet fixed the* blame for the accident. However, it is readily apparent from the findings of the Board of Investigation that the nickel iron battery, while adding practically nothing to the safety of the submarine, introduces an element of danger which does not exist in the lead type of battery.

The Libraries of Washington

IT is doubtful whether any other city in the world has so great a number or such a variety of public and quasi public libraries as Washington, and especially so many large collections of books devoted to particular branches of knowledge.

The average visitor to the capital finds his way, as a matter of course to the Library of Congress, and is duly impressed by such facts as that this institution, with its hundred miles of shelving, representing a capacity of 3,540,000 books and 84,000 volumes of newspapers, has at present a collection numbering about 2,250 000 volumes. From these figures he is apt to conclude that every class of literature is almost exhaustively covered by this institution, and that the national library is therefore the most likely place to find any particular work, or works, on any particular subject. The fact is, however, that the Library of Congress is a poor place to seek books on a great many subjects.

Washington is a city of special libraries. Thus it happens that the geologist does not go to the Library of Congress for the literature of his science, but to the library of the Geological Survey, which contains 90,000 books and 100,000 pamphlets, dealing almost exclusively with geology and closely germane subjects. The medical man finds only an insignificant collection of medical literature in the Library of Congress, compared with the half million medical books and pamphlets in the library of the Surgeon General of the Army—the leading medical library of the world. The most nearly complete collection of United States public documents extant is that contained in the library of the Superintendent of Documents, which is attached to the Government Printing Office. It numbers 147,855 books and pamphlets, and 16,289 maps. The library of the Department of Agriculture contains about 131,000 books and pamphlets on agriculture and other branches of science that enter into the work of the department. This does not include the library of the Weather Bureau, which has a collection of 33 000 works dealing chiefly with meteorology and climatology. Military science is represented in Washington by two large libraries, which have just been merged into one, viz, the library of the War Department with 60,000 volumes and 40,000 pamphlets, and the library of the Army War College, with 34,427 volumes. The Navy Department has a technical library of about 50,000 volumes. The Naval Observatory has the largest collection of astronomical literature in America, amounting to 27 200 books and 5 452 pamphlets. The State Department library contains about 7,000 volumes, devoted chiefly to international law, diplomacy, history, foreign laws, and descriptions of foreign countries. The Patent Office has a magnificent library of technological literature, numbering 94,648 books and pamphlets. The Bureau of Standards has 11,166 books and several thousand pamphlets, on physics, technology, and the like. The Coast and Geodetic Survey has 25,000 books and pamphlets, 35 000 maps, charts and blue-prints, and much manuscript material, all relating to the subjects embraced in the work of the Survey. The Smithsonian Institution deposits most of its books at the Library of Congress, but the National Museum, which is a branch of the institution maintains an independent library of 43,692 books and 72,012 pamphlets pertaining chiefly to the natural sciences. The Bureau of Mines has a collection of about 12,000 volumes, relating especially to mines and mining, including a large number of mine accidents. The Bureau of Education has an unrivaled pedagogical library of 145,000 volumes and pamphlets. This library lends books by mail to educators and school officials throughout the United States. (Most of the Washington libraries lend to *libraries* throughout the United States, so that their splendid resources are available to students all over the country.)

The Columbus Memorial Library of the Pan American Union has 28 390 books and pamphlets relating to Latin America. The literature of Freemasonry and kindred topics is represented by about 100 000 books and pamphlets in the library of the Supreme Council of the Thirty-third Degree. The Volta Bureau contains an immense but unnumbered collection of works pertaining to the education of the deaf and germane subjects. There are two large libraries of railway literature in Washington, viz., that of the Interstate Commerce Commission, with 16 000 volumes and 10,000 pamphlets, and that of the unofficial Bureau of Railway Economics, with about 25,000 books, pamphlets, and maps. The law library of the Department of Justice contains about 45,000 books and pamphlets, while there is still a larger law library attached to the Library of Congress, and one of about 16,000 volumes at the headquarters of the Bar Association of the District of Columbia. The Bureau of Labor Statistics has about 28 000 books and pamphlets on labor problems and similar subjects. The Bureau of Fisheries has 28,695 books on ichthyology and other topics in which the bureau is interested. The Engineer School at Washington Barracks has a library of about 50,000 books and 8,000 pamphlets, devoted to military and civil engineering, etc. The Census Bureau has a statistical library of 28,970 books and 89,418 pamphlets. The Bureau of American Ethnology has 31,709 books and pamphlets on appropriate subjects. Last, but not least, Washington has a great public (Carnegie) lending library, and large libraries attached to each of the local universities and colleges, besides small libraries connected with schools, clubs, etc. Altogether there are 137 public, semi public, and society libraries at the capital.

Probably the greatest need in special libraries at Washington is one devoted to geography. Although the Library of Congress has a magnificent collection of maps, it is weak in other branches of geography, and the capital has no library analogous to those of the American Geographical Society in New York and the Royal Geographical Society in London.

Automobile Notes

A Jitney Problem.—Jitney drivers have discovered that there is a considerable difference in the profit to be made from different passengers. For example, a fat man occupies 15 cents' worth of room, but pays only a nickel, and as a consequence the wise jitney usually fails to see a stout passenger seeking a ride.

Adjusting Lamps.—A large portion of the light from the average lamp is projected upward, and above the level of the lamp, and this portion of the light not only serves no useful purpose, but is largely the cause of the glare that is so objectionable to every other user of the road. It is a simple matter to so adjust the lamps that the light is thrown downward, and this not only obviates the glare, but concentrates more light on the road. A little judgment in adjusting lamps would result in benefits to everybody.

Another Alcohol Fuel from Transvaal.—About a year ago a new alcohol fuel mixture was introduced in South Africa, under the name "Natalite." The discoverer of this fuel now announces that he has been able to increase greatly the efficiency (in thermal units) of his fuel, by adding certain other ingredients. His new mixture is called "Ethol" and, according to the report of Prof. Orr, of the British School of Mines and Technology, gives 2½ per cent more in thermal efficiency than gasoline. The consumption is at the rate of 105 gallons per brake horse-power, as compared with 125 gallons where gasoline was used. The "Ethol" mixture, however, was used in the gasoline engine without the slightest change or adjustment to the carburetor.

Powerful Tractor Made in America.—Built according to specifications for a powerful tractor to move the heaviest mobile artillery, which were received by a Springfield (Mass.) concern from the French and British governments, a new tractor is now available for American building and contracting firms which surpasses all previous vehicles of this type. The new tractor recently picked up, without much difficulty, a huge flat truck on which was loaded an immense boiler weighing more than 66,000 pounds, the truck itself weighing over eight tons. The total dead weight moved by the four wheeled tractor was therefore 41 tons. The usual requirements for moving such a load by means of horses would have been a team of 28 strong animals, with 10 extra horses and a block and tackle for starting.

Getting after Vibration.—In the not very distant past many automobile manufacturers gave but casual attention to the balancing of their engines trusting to the vibrations of the road to disguise those due to the engine or divert attention from the engine builder to the road builder or the tire maker. Great improvements have been made, however, for it has been realized that proper balancing means much to the efficiency and life of the entire machine as well as increased comfort to the user and the advent of the eights and twin sixes brought the subject still closer to the designer. There is still much that can be done in the way of balancing moving parts and eliminating vibrations, and our best engineers are giving the subject careful study, although the frequent changes of model delays the results.

Circuit Tester Helps Repairs.—The extraordinary increase in multiple-cylinder motors for automobiles has caused a great demand for experienced electricians in garages and repair shops because of the difficulty in locating electric wiring troubles, and properly connecting the maze of wires in the modern motor car. An instrument which greatly lightens this task is an electric circuit tester which has just been brought out by an Illinois manufacturer. It is composed of a telephone receiver, a cord with plug which screws into any electric light socket, and a long flexible cord with the proper terminals for connection. When trying to find short circuits, broken circuits or proper connections in the wiring system, the circuit tester will indicate them in a few seconds. The manufacturer thinks so well of the instrument that he agrees to send it on 10 days free trial.

Heat in Tires.—It is well known that after a long and fast run the tires of an automobile are found to be very hot, and many have supposed this is the result of the friction of the tire on the road. Such is however, not the case, at least as to the greater portion of the heat. The real cause of heating is the internal friction of the tire itself, for as the tire is being constantly deflected by contact with the road, the various plies or layers, which compose the tire do not act uniformly, and consequently there is more or less motion between them, that results in friction and heat. The greater the change in shape in the tire as it contacts with the road the greater will be the friction. Of course the harder the tire is pumped, the less will be the deflection, but it is evident that while a perfectly rigid tire would generate but little heat, it would fail in giving easy riding, so we must put up with some heating and consequent wear of the tire. The subject is one that is being successfully studied by the tire maker.

Science

A New Automatic Transpiration Scale, for the study of the transpiration rate of plants, is described by Messrs. L. J. Briggs and H. L. Shantz, in the *Journal of Agricultural Research* for October 18th. It is so designed that the plants may be freely exposed to the weather, and is of large capacity. The same article reviews the various forms of transpiration balance that have been heretofore in use.

The Crocker Land Expedition, under Donald B. MacMillan, is spending another winter in the Arctic. The steamer "George B. Cluett" which went north last autumn to bring the explorers back is ice-bound in North Star Bay about 120 miles from the expedition's base at Etah, Greenland. Letters received by way of Copenhagen reported all hands well and preparing for a renewed campaign of explorations during the winter and spring.

The Talgai Skull, the relic of Pleistocene man in Australia which was exhibited at the Australasian meeting of the British Association, has been presented to the University of Sydney. The skull was found near Talgai in the Darling Downs, Queensland and is completely mineralized. According to Prof. Edgeworth David it may be that of a member of the first human family to cross Wallace's line and introduce the dingo (a sort of Asiatic jackal) into Australia.

A New Isogonic Chart of the United States, showing the general distribution of magnetic declination over the country on January 1st, 1915, has been published by the Coast and Geodetic Survey to supersede a similar chart published in 1910. It is based on about 6,000 values of declination, including about 800 in Canada and 300 in Mexico and the West Indies. The lines on the chart are generalized with respect to local irregularities but the latter so far as data are available are indicated by entering on the chart isolated abnormal values differing by more than a degree from the normal for the locality. A disturbed area of some extent indicated by observations at several places is represented by a small closed curve. In consequence of this plan the isogons on the chart have a more regular appearance than those on the chart for 1910.

Trench "Frost-bite."—An article in the *Lancet* discusses the so-called "frost bite" from which many soldiers suffered while fighting in the trenches in Flanders last winter. It is characterized by swelling, pain, and disturbance of sensation in the part affected, but not by the necrosis or death of the tissues which occurs in true *frost bite*. The names "*frigorism*" and "*frigidism*" have been suggested for it. The conditions causing it are cold, wet and interference with the circulation in the leg and foot by tight puttees and boots. A very thin layer of moderately dry air between the skin and the external cold water or ice enables the heat of the circulating blood to keep the parts free from "frigorism," and this can be secured by wearing bags of very soft, thin oil skin on the lower limbs, in conjunction with woolen socks. *Nothing tight must be worn around the leg.*

Storm Warning Lanterns.—At the solicitation of marine interests especially on the Great Lakes and also in pursuance of a plan recommended recently by the commission on storm warnings of the International Meteorological Committee the U. S. Weather Bureau is preparing to introduce a new system of night storm warnings, consisting of three lanterns in a vertical line, instead of the two lanterns heretofore employed. By this arrangement it will be possible to indicate the expected direction of the wind to the nearest quadrant instead of to only two directions. Experiments recently conducted by the Bureau show that in order to be seen separately by the naked eye, lanterns should be approximately four feet apart for each mile the observer is distant. To secure great brilliancy a standard electric lamp of the gas filled tungsten type is being tried out. The new system of lanterns is being first installed on the Great Lakes.

Human Characteristics in Apes.—Mr. R. L. Garner who has devoted the best years of his life to the study of the African anthropoid apes in their native haunts recently delivered a notable address before the Biological Society of Washington on the habits and social conditions of these animals. In many respects they resemble closely the lower races of humanity. Their diet is mainly vegetable, but flesh is an essential part of it. They sleep on the back or side, like human beings, and often make their beds 18 to 25 feet off the ground. They have acute sight and especially hearing, but their sense of smell is not much better developed than that of man, while the sense of touch is less acute than in man. The period of gestation is probably seven months. Twin births are exceedingly rare. Females are sexually mature at from 7 to 9 years, males a year or two later. The usual duration of life is 20 to 21 years. Rights of ownership are well respected among them.

Industrial Efficiency

Electric Drive in Textile Mills.—The total cost of electrical equipment for textile mills, according to J. R. Olnhousen in the *Electrical World*, is about 10 per cent of the complete cost of the mill. The annual cost of power is from 4.5 to 5 per cent of the total cost of the manufactured products. Experience with up-to-date motor drive shows an increased production over mechanical drive of from 5 to 7.5 per cent.

Long-Handled Shovels for Forced Firing.—As a result of feeding fires under boilers operating at 175 per cent rating, the firemen of a Middle West electric power plant suffered from blisters on the exposed parts of their bodies. The company solved the difficulty by providing the firemen with long handled square ended coal shovels which while not impairing the dexterity with which the toilers fed the fire, saved the men from the intense heat.

Prompt Medical Attention and Its Rewards.—Even the smallest scratch on the hand sends a Bethlehem Steel Plant employe to the dispensary. There is no debating whether this or that hurt is sufficient to make the laborer stop work—it is compulsory that the doctors *do the deciding*. *More than 90* out of every 100 men can immediately return to their work after the necessary medical precaution has been exercised. When it is recalled that injuries at first no more serious than a slight scratch may lead to the amputation of a limb or even death, the reason why 1,300 or more toilers visit the dispensary of the Bethlehem Steel Plant every week is at once apparent.

Paper Made from Grass.—It is reported that the Department of Agriculture is experimenting with wire grass as a source of supply for pulp for making paper, in place of poplar or liriodendron. This variety of grass grows on the Pacific Coast and in western Mexico, and possesses the very desirable property of toughness and can be reduced by the soda process. It is stated that paper manufactured from the stock has proved as satisfactory, in physical tests, as a first grade machine-finished printing paper. In appearance and in feeling, the paper produced is satisfactory. However, the experiments have indicated that more bleaching powder is required in the bleaching process than in the case of poplar stock.

Rules for Abating Smoking Stacks on Vessels.—The Department of Health of New York has recently issued a folder addressed "to owners of steamboats" and containing much valuable information in regard to the abatement of smoke. Not only does it instruct boat owners how to avoid smoking stacks, but it also deals at length with the advantages that accrue by so doing. The following rules for firemen are given: 1.—Fire one half of the furnace at a time and wait until the smoke stops before firing the other half. 2.—Keep the door open slightly for about two minutes after firing. 3.—Fire a small amount of coal at a time. 4.—Keep fires clean and ash pan free of ashes. 5.—Carry a level fire. 6.—Break lumps of coal into small sizes before firing. 7.—Use steam jet. 8.—Maintain a steady water level.

Winding Watches by Electricity.—While the winding of one's watch would seem to call for but a small amount of energy it assumes a most significant aspect when multiplied several hundred times, as in the instance of a watch repairing concern in New York City, part of whose work it is to wind 700 watches or more each day. To facilitate the work the firm makes use of an electric motor which drives a small felt lined socket through friction drive. It is only necessary to start up the motor and hold the stem of a watch against the felt lined socket to wind the time piece. When the watch is completely wound the tightened spring overcomes the pressure between the motor pulley and the friction disk, with the result that slippage takes place. Simple as this electric watch winding equipment is it has replaced several men formerly required for the work.

Quartz Glass Now Made in America.—As a result of the war the United States has entered into a new industry, namely the manufacture of quartz glass. Heretofore this product has been manufactured in Germany and imported into this country in large quantities despite the high tariff. Curiously enough, the glass has always been made from a peculiar kind of sand which is found only in Nebraska. Thousands of tons of this sand in the past have been shipped to German glass factories and returned to the United States in the form of finished glassware, such as crucibles, test tubes, retorts and other similar articles employed in chemical laboratories. So great was the demand for quartz glass or Silicium Dioxide (SiO_2) in this country that previous to the war it was found advisable and even profitable to mine the sand in Nebraska, transport it in bulk to Atlantic seaports and across the ocean to Germany and, after the glassware had been manufactured, to return it in the finished form to American markets. The advantages accruing from the new industry are too obvious to be mentioned here.

Sectional view of the U. S. supply ship Culgoa

Supply Ships of the Navy

Importance of Auxiliary Vessels to Our Fleets

THE contention of the great Corsican that an army travels on its stomach finds an equal application to the great fleets which constitute naval armaments. The majesty and grim potential strength apparent when a huge warship's impressive bulk fills the delighted eye of the layman is apt to overshadow realization that no mere warship nor even fleet of fighting units alone, can successfully undertake operations distant from the base or for a period of long duration unless auxiliary vessels maintain unfailing service of supply.

In the maintenance of a proper meat supply to the fleet, supply ships of the navy find their most important function. While many other elements of ration and equipment are transported by these ships the great refrigeration holds of this class of naval auxiliary make it necessary that special ships be either built or altered for the handling of beef. The average battleship now in service is supposed to carry sufficient meat and ration supply to last about a month without renewal. When a ship of this class sails for foreign waters there are probably 40,000 pounds of meat aboard.

As there is never assurance that a ship will not be called upon in an emergency for a sudden departure, supplies aboard are rarely permitted to fall low. For this reason, though a battleship might stock up for a greater period of time, while away from its base each ship is supposed to be visited at least once a month by a supply ship.

About one fourth of the cargo space of a supply ship is given over to meat storage. The "Culgoa," "Celtic" and "Glacier," supply ships of the United States Navy, when they leave on a visiting trip carry five or six hundred thousand pounds of beef, frozen hard and maintained at a proper temperature. This amount of beef is sufficient to supply the Atlantic fleet for about one month.

On the Atlantic station there are two supply ships—just two less, according to the opinion of duly qualified naval officers, than desirable for an ample war service. There is one supply ship on the Pacific station, while the only ship of this class expressly designed for the purpose is now under construction at the Philadelphia Navy Yard. The other supply ships of the Navy are converted freighters.

During days of peace as, for instance, when the fleet is engaged in maneuvers near Guantanamo the "Culgoa" and the "Celtic" alternate each month in sailing with supplies from some port of departure to the fleet rendezvous. After replenishing the larders of the main fleet, the supply ship proceeds to pick up the various vessels scattered on the station.

The refrigeration holds of supply ships are heavily insulated by casings of wood and zinc packed with charcoal. These insulations have been built in after a remodeling of the interior structure of the ship to meet requirements. The compartments are kept at a temperature of about fifteen deg. below zero.

There are, in addition to the below zero sections, others for the stowing of supplies which must not be allowed to freeze. There is one compartment, with a capacity of about 4,000 cubic feet entirely given over to the storage of hundreds of thousands of eggs, side by side with quantities of butter.

Other holds are devoted to vegetables and "dry stores," onions, potatoes, beans, &c., and rows of flour barrels flanked by boxes of prepared provisions. Canteen stores such as candy, jam, cakes and small articles for personal use, are delivered to ships which have previously purchased them. It is surprising how much candy is sold aboard a ship.

In addition to carrying articles of food, these ships form a sort of express service to the fleet, delivering requisitioned articles of equipment, even to guns, for which there is space. They frequently carry ammunition supplies, a large magazine being provided in each ship for the purpose.

Speedy Patrol Boats for the U. S. Navy

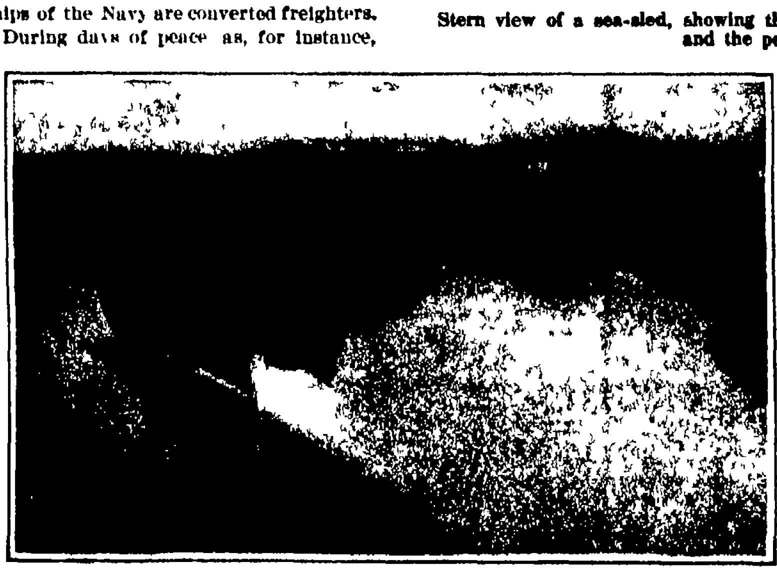
THE novel motor boats known as "sea-sleds," originated by a designer in Nova Scotia, have been found so speedy and also so dry and steady in rough water, that they have been adopted by the United States Navy for various purposes, and recently a specimen of this type has been tried out for duty as a fast patrol or picket boat, for which work it is expected that it will be particularly efficient. Armed with a couple of light rapid fire guns a boat of this kind could easily run down the most powerful submarine, and its great speed should enable it to avoid the shots fired by craft of any kind.

As will be seen from the illustrations the sea-sled is not a handsome craft, but greatly resembles a scow, with flat, vertical sides and square bow and stern. Its special feature is the underside arrangement, for the member that answers as a keel starts at the middle of the deck, at the bow, and extends, by quite a flat curve, to a point near the stern, where the bottom of the boat is flat. This construction forms a gradually diminishing V-shaped trough extending longitudinally through the hull, and the outline of the boat in the side view shows the chine at the lower edge of the vertical side, and not the keel line.

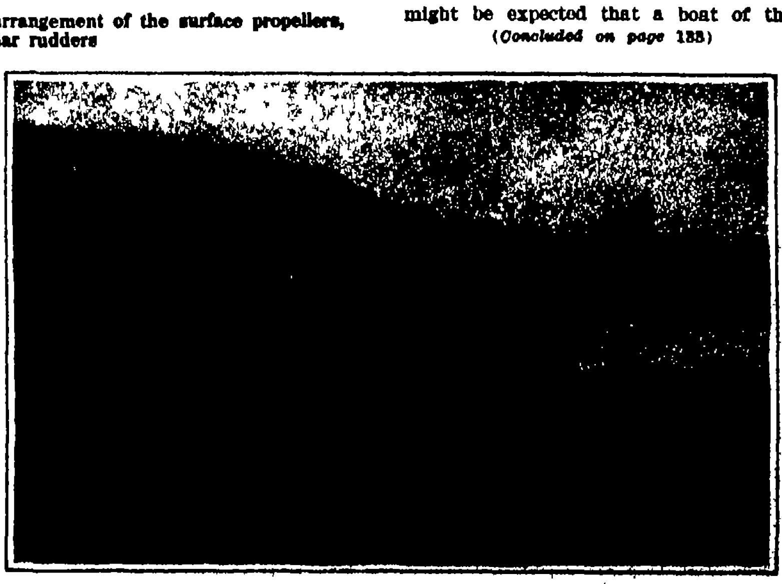
As the sides are flat and vertical, and as the width of the boat is somewhat greater at the bow than the stern, there is no tendency to throw water above the deck line, but on the contrary all spray is collected in the V-shaped opening at the bow and carried under the bottom, thus making a very dry boat in rough water. It is claimed that considerable quantities of air are also collected by the V-bow, and forced under the boat, so that it rides on a cushion of mixed air and water. It might be expected that a boat of this

(Concluded on page 133)

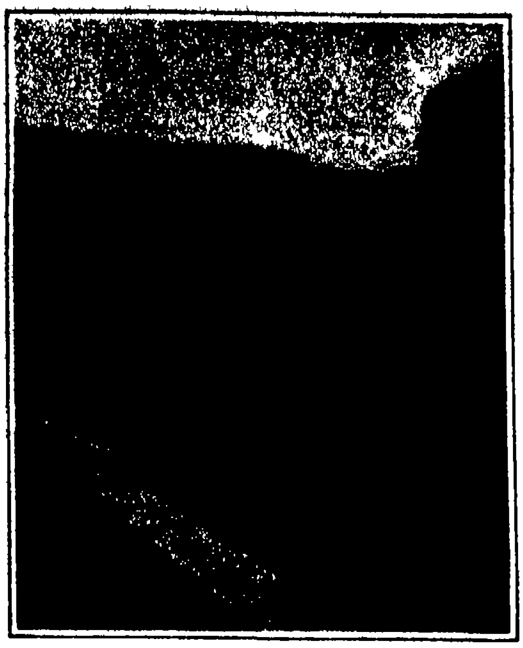
Stern view of a sea-sled, showing the arrangement of the surface propellers, and the peculiar rudders



When it starts, the sea-sled churns up a great cloud of spray behind



The sea-sled running at high speed. Note how smoothly it glides over the water



San Miguel River Canyon, showing the flume along the right-hand wall

San Miguel River Canyon Flume—A Monument of Gold Mining Failure

By W F Wilcox

IN the rugged region of western Montrose county, Colorado, there are the relics of a dreamer s scheme to get gold. Along the precipitous sandstone cliffs of the San Miguel river, which winds its tortuous way towards the Rio Dolores, cutting in two the magnificent carnotite field, is a flume which is at once a mechanical wonder and a reminder of a colossal failure

There is pay dirt at Hydraulic, near the Colorado-Utah line, where the placer outfit was located It assays from 75 cents to $1 25 a yard It was back in 1890 that a St. Louis concern dreamed of a placer mining proposition to save these values and make a mint of money

Water was to be taken out of the San Miguel river somewhere near the Club ranch and diverted by means of a flume, out of the depths of the canyon until the location of the property was reached In order to secure the required fall to the flume and bring the water out of the deep cut, some 12 miles of flume were required and all of it had to be hung on the rocky sides of the canyon, as depicted in the accompanying views.

A contract for 3,000,000 feet of No 1 pine lumber was let to two men of Montrose. The lumber was sawed at Pine Flats on the Colorado-Utah line in the La Sal mountains It was a most difficult country to get into. Entrance was secured at White river, where the railroad was left behind Seventy miles of wagon road had to be built to the timber lands in order to get the machinery through, especially the big five-ton boiler

From the lumber mill there was a gigantic road proposition to the site of the flume As an illustration of the extreme gradients encountered, in one section of five miles a drop is made from 9,000 feet elevation to 4,000 feet. Many an accident happened to the eight mule team outfits that freighted the lumber over this rugged land The two lumber contractors agreed to deliver the lumber at $22 per thousand feet, and in view of the conditions just mentioned it is needless to state that they became bankrupt. It was the long haul of 22 miles that contributed most towards their failure.

But the lumber contractors were not the only losers and by no means the largest.

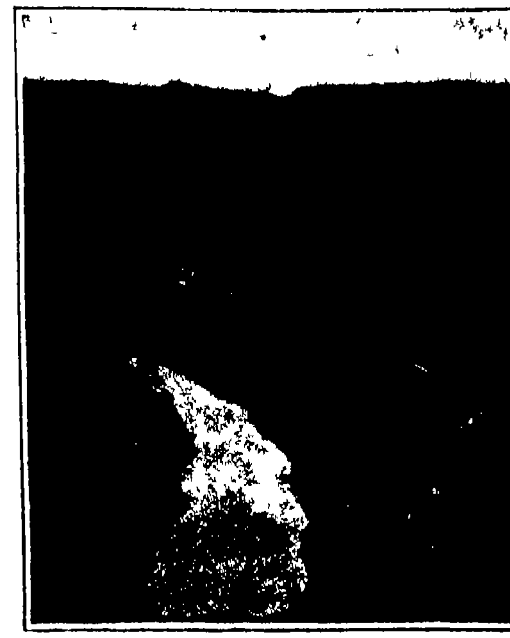
The making of the flume was a wonderful undertaking. Men were hung over the rimrocks and lowered by ropes into the canyon. Here they worked in the boiling hot sun. They were suspended anywhere from 150 to 500 feet down from the top of the canyon, with a yawning chasm below them. Their work was tedious under the circumstances first, a hole had to be drilled into the rock, next, a specially made iron piece was inserted in the hole, then a board was lowered and fitted over the end of the iron and a tap screwed on A brace was then fitted into the rock below and set up snug against the timber Following this planks were lowered and a 16-foot section of flume finished On the average, five or six men laboring for 10 hours finished a stretch of 128 feet of flume Frequently the men lowered over the ledge had to pull themselves under overhanging and projecting rocks. In one instance, for a hundred odd yards the flume is really over on the opposite side the walls project to such an extent that anything dropped from the flume will fall on the opposite bank The flume which is 6 feet wide and 18 inches high required about two years to construct The lumber contractors were a year and a half delivering the lumber

While the ground assays good gold values, the company was unable to save any The gold is in the form of "flour" gold, which is too fine for hydraulic or placer working It is said that the company took out $5 worth of gold and then abandoned the project At any rate, the company never paid out and in a few years the property was sold for taxes by Montrose County A Chicago company secured title by paying a thousand dollars for the tax receipt, thus coming into possession of a property that cost over a million dollars.

Under the control of the new company, more improvements were made and new machinery and processes installed, but even the infusion of fresh capital could not make the undertaking pay out, for the gold refused to be reclaimed The manager went back to Chicago to report, and later committed suicide because of some misunderstanding with the promoters, which arose over the property

To-day the flume hangs along the side of the San Miguel River, a relic, a monument to the failure of two big gold mining concerns and a lumber contracting company and the suicide of a man Although it must have cost upward of a million dollars it lies without an owner, disintegrating in the terrific sun that is reflected along the mighty cliffs of a desert land

People attracted to the western Montrose region at the present time by the carnotite radium activity marvel and wonder at the temerity of any man who would propose such an undertaking A more successful mining scheme is now being worked to a successful issue in that very region, which is the world s greatest radium deposit, furnishing, as it does, about 95 per cent of the total supply The country surrounding the San Miguel is rich in radium, and the properties, camps, mines and concentrating mill of one of the leading mining concerns is located beside the flume.



Another view of the San Miguel River Canyon and the remarkable flume

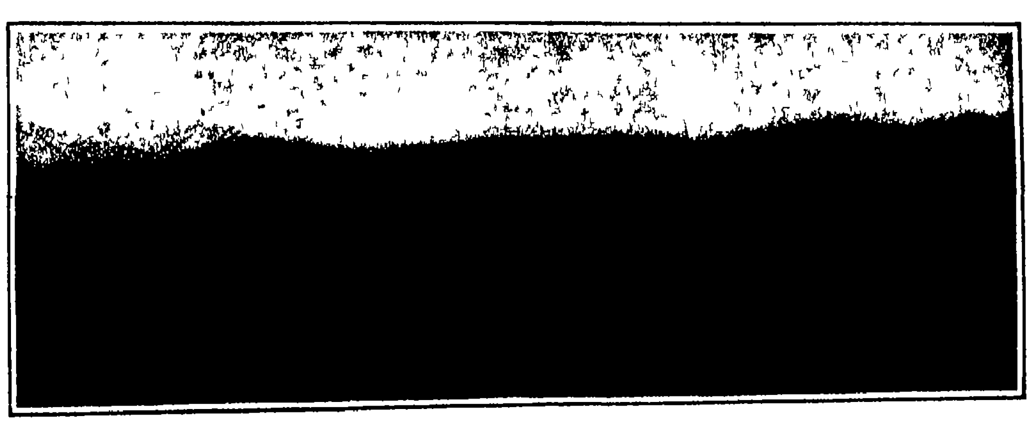
A scenic highway is being projected along the river canyon on the opposite side of the flume, which when completed, winding along the depths of the canyon down to the Dolores and out through the famous Gate Way in Utah, will be without exception one of the most wonderful scenic automobile routes in the world

Destruction of Vegetation by Fumes from Smelters

SERIOUS trouble is being experienced in Tennessee and Georgia on account of the sulfur fumes from plants of the Ducktown Sulphur, Copper & Iron Company, and the Tennessee Copper Company In 1905 the State of Georgia took action against these companies, alleging that they permitted a discharge of gases which destroyed vegetation, including forest trees, in that state Both companies were forced to install plants to utilize a considerable percentage of the sulfuric acid gas. These plants, however, have been unable to utilize a sufficient quantity of the gas, and last Spring the Supreme Court decided to have a special expert ascertain the amount of gas released and the amount which ought to be utilized in order to make the fumes harmless. The report is expected to be made soon.

Officials of the Forestry Service think the time is close when the Government will have to take up this question of fume damage, since large sections of the Cherokee Area are subject to such damage and it is reported that the injury has extended to the Georgia Area

A study may be made of the sulfuric acid industry in the Eastern states to find out whether, if the sulfuric acid from such places as the Ducktown plants were fully utilized it would make possible a reduction in the cost to farmers of acid phosphate, which has become an important fertilizer throughout the East



View of a portion of Ducktown, Tenn., depicting how all the vegetation has been killed by the sulfur fumes from nearby smelters

Striking example of erosion caused by deforestation of great areas due to the sulfur fumes from the Ducktown smelters

The Northeast Passage Again Achieved

PRESS reports quoted in the *Scottish Geographical Magazine* announce that the Sverdrup and Vilkitskii arctic expeditions in their three ships, arrived safely at Archangel in the middle of September As the Vilkitskii party started last year from Vladivostok, this report means that the feat of sailing around the arctic coast of Eurasia—the Northeast Passage—so often attempted in vain, has been achieved by the same Russian naval officer who discovered Nicholas II Land in 1913 The only previous expedition to make this passage was that of Nordenskjöld, in the "Vega" which traveled in the opposite direction (eastward) in 1878-79 Why has not Vilkitskii's latest feat been reported conspicuously in our newspapers?

German Commercial Preparedness for Peace

An Englishman's View of Germany's Industrial Activity and Prospects After the War

By James Armstrong

THOSE who have supposed that Germany's commerce and industries have been so seriously crippled by the existing war will find much food for thought in the present article which we have reproduced in full from the British World's Work Mr Armstrong describes the situation from the English point of view with much apprehension and strikes a note of warning which should be heeded in this country as well It emphasizes the importance of our own Industrial Preparedness for Peace.—EDITOR.

SO absorbing and vital, especially in this country, is the necessity to produce munitions for the main tenance of destruction that the more critical require ments of commerce are in danger of being overlooked The period of maximum pressure has passed Our industries have been so effectively mobilized, the handicap in raising the provender of destruction has been overcome, with the result that now we are able to take brief breathing spells The fact that the crisis has been passed is officially revealed by the abolition of Sunday labor

The organization of our facilities for the prosecu tion of the war having enabled a certain output to be achieved and maintained it is now possible to look round and to estimate the general state of affairs not only in regard to pressing needs, but of the future when cannon and shells will have to make way for plows and pens The moment when the latter will be required may spring upon us with dramatic sud denness Indeed there is every indication that the change will be as cataclysmic as was the declaration of hostilities

Under these circumstances the question arises "Are we ready for peace? According to the out ward and visible signs the reply is an emphatic nega tive If the transition of our factories from war to peace is likely to occupy anything approaching the time required to convert them from peace to war then we are confronted with a situation as dark and dreary as the first six months following the invasion of Bel gium and France

We are somewhat lethargic in our movements and apathetic in matters regarding the future We differ from the German in that we think only of one thing at the time

Now the methodical Teuton maintains that peace and war must run in single harness He and his newspapers are now full of talk of 'preparedness for peace" Even as its industries were organized to secure the commercial position of Germany in the sun so will the hundreds of factories which have been raised and equipped during the spasm of war be subsequently devoted to the exigencies of trade

The world wide catastrophe has taught Germany many severe lessons apart from her military miscalcu lations. They are lessons which have not been brought home to the Allies because our circumstances have been so vastly dissimilar

Germany has been blockaded and has been forced to realize that many articles for which she was for merly dependent upon others outside, either had to be made within the country or gone without

Evidences of this condition of affairs are revealed on every hand In pre-war days she was the largest customer for Chilian nitrates with which to fertilize her hard worked ground Before many weeks of war had elapsed she was faced with a critical situation

Foodstuffs would have to be raised within the country In order to secure the maximum yield per acre there was a heavy call for fertilizer But the stocks of Chilian nitrates were so slender that they would be speedily exhausted To maintain the food supply a substitute would have to be found

Some years ago a commercial factory for the ex traction of nitrogen from the air was established in Norway and it has proved a remarkable commercial success Germany purchased extensively from the factory, but the manufactured article was forced into competition with the natural product from the slopes of the Andes, to the disadvantage of the former

If Norway could render the process remunerative and successful Germany certainly could do likewise That was the Teuton argument and without any further delay the process was taken in hand

Food from the Air

Another motive governed this development Nitric acid was in acute demand for the manufacture of high explosives It could be derived in vast quantities if the extraction of nitrogen from the air were taken up The leading German company devoted to this process placed orders for the speedy erection and equipment of several extensive installations

The contracts for two nitric acid producing estab lishments were placed with the Allgemeine Electri citäts Gesellschaft of Berlin while another concern placed a further contract with the same organization for the equipment of an electrical station which ranks far and away as the largest single order of its charac ter ever carried out in Germany

Another plant which is far more ambitious and com prehensive is also under way Some years ago a com pany was established to provide the city of Berlin with electricity for lighting, heating, and power The con cern anticipated that, upon the expiry of the initial term, it would receive a renewal of the concession for a further number of years, and to this end it acquired extensive lignite fields near Bitterfield in order to be in close proximity to an abundance of cheap fuel for generating the requisite current But the civic author ities decided to exercise their option and to buy out the private company

Under these circumstances it appeared as if the lig nite field investment would prove a white elephant. But the war invested the situation with a totally dif ferent aspect The government demanded vast quan tities of fertilizer for the satisfaction of the farmers and truck garden produce raisers, as well as nitric acid for explosives The private company was ap proached and urged to assist in meeting the national necessity by embarking upon the 'fixation of nitro gen" process

Nitrogen at 1½d a Pound

With the money received from the Berlin City Fathers as the price of the electrical undertaking the original concessionaires laid down a huge plant upon the lignite fields the whole of which extending over 2,500 acres has been purchased. Here are sufficient supplies of cheap fuel to keep the works going for some thirty years at full pressure

A subsidiary company has been inaugurated to carry out the actual work of fixing the nitrogen' with drawn from the atmosphere, and this concern has con tracted with the electric generating company to buy sufficient current to enable 66,000,000 pounds of nitro gen to be extracted in this manner per annum at an average cost 1½d per pound for fifteen years, with the option to extend the agreement a further ten years

The initial section of the scheme has been completed and has been attended with such conspicuous success that the plant is to be extended in order to ensure double the yearly output of fertilizer

In view of the enormous developments of the many extensive plants which have been laid down to exploit this process of producing fertilizer it is obvious that Germany will depend less than formerly upon Chile for supplies when peace is declared The capital in vested in these enterprises is too huge to risk com petition If the nitrogen food factories were forced into inactivity by the natural product, then the elec tric generating stations would have to close down also inasmuch as they would be deprived of the markets for their current.

There is another feature which must not be over looked Under normal conditions the establishment of such works entailing a heavy expenditure of money would demand the preservation of the initial outlay or depreciation allowances in the annual balance sheets until such time as the capital outlay has been extin guished But when peace is declared and these fac tories settle down to their usual routine the item of capital expenditure, representing the cost of erecting and equipping the buildings will not appear These charges will have been extinguished by the govern ment in the form of payment for nitric acid

In other words, the war in Germany is financing the industries which at a later date will plunge the world into a commercial conflict, which is certain to be waged as bitterly as that now running its course

Dependence upon Coal

Similar conditions prevail in the coal industry Since the outbreak of war the German coal gas pro duction has advanced by leaps and bounds at the in stigation of the government The latter has been loud and insistent in its demands for these products of coal gas distillation which are indispensable for war

Shut off from the great oilfields of the world, Ger many has been compelled to rely upon its home products for running the Diesel engines of its sub marines the light engines of its aircraft, and the heavier motors of its automobiles. The gas is wrung to the last drop to extract the benzol for the foregoing purposes, toluol for T N T, carbolic acid for disin fectants, cyanogen, the deadly gas which is employed in the poison-gas war and the preparation of asphyx iating shells, and ammonia, which, in the form of sul phate of ammonia, serves as a substitute for saltpeter, which can no longer be imported.

But in the practice of the arts of war those essen tial to peace, which have no military significance, are neither ignored nor wasted The tars arising from the manufacture of the coal gas are rich in the elements for the production of aniline dyes. At the moment these may be regarded as by products, merely because there is no, or only an extremely limited, home market for them Consequently the dyes are being stored up in huge accumulations awaiting the arrival of the op portune moment for flooding the whole world with them

The Aniline Dye Crisis

At this time the shortage of aniline dye-stuffs is af fecting the whole world to a very serious degree. Only recently a keg of a certain color happened to come up on the market through a forced auction sale Nor mally a keg of this particular dye can be purchased for some sixty shillings, but so pronounced is the dearth of this color, that this solitary keg called a bid of some £312 before the hammer fell There are other dyes for which not only this but other countries are in urgent need, and these colors have risen to pro hibitive prices

Efforts to ease the situation are being made in this country and the United States, but they are of almost negligible significance An elaborate and well equipped aniline dye manufactory, capable of compet ing with the German organizations upon level terms, cannot be brought into operation in a day It has taken Germany many years to establish this industry, which is now virtually a world wide monopoly

The result is that Germany does not view British French or American activity in this field with the slightest apprehension She could flood the market to morrow so effectually that every competitor, coming into existence during the war, would not merely be snowed under but wiped out of existence

No firm will be able to sell aniline dyes at the prices which the German trust will unload them It must be remembered that the cost of producing these enor mous stocks have been defrayed The Teuton govern ment has not only paid a high price for its essentials from coal gas distillation, but also for the waste as well, and the dyes could almost be given away at a profit

A similar story may be traced through every rami fication of German industry Every factory which has been impressed into the service of war is at liberty to carry on as usual to a certain degree There is no immediate demand for its specialties owing to the ex port market being closed, but Germany recognizes the imperative necessity to possess fully charged commer cial magazines against the critical moment which must dawn.

Huge Profits

Those who labor under the apprehension that Ger many's industrial companies are passing through a cri tical period and are faced with bankruptcy will receive a sudden awakening Take, for instance, the All gemeine Electricitäts Gesellschaft, the mammoth electrical trust. During the year 1915 it earned a gross profit of £11,544,000 and paid a dividend of 11 per cent upon its share capital of £7,750,000

The dividend was 1 per cent in excess of the previ ous year, and this notwithstanding that taxes were up £40,000, and that bonuses to staff and pensions were increased by £15,000 and £25,000, respectively, while there was a further expenditure of £230,000 on war allowances. The gross receipts were £412,000 above those for the previous year

"Oh, the increased profits are due to payments for munitions!" So explains the ordinary person. But are they?

In common with all other industrial concerns in the Fatherland the Allgemeine Electricitäts Gesellschaft has been called upon to supply shells, grenades, car tridges, and so forth to meet the desires of the mili tary, but at the same time it has been exceedingly busy on its normal work of building electrical equip ment. True, this has been absorbed by the factories which have come into existence for supplying other government necessities, but if the statements of the officials of the trust are to be credited stocks have been maintained at a high level to meet all and any emergency.

(Concluded on page 139)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Student Military Training

To the Editor of the SCIENTIFIC AMERICAN

I have been reading your fine articles and editorials on "National Preparedness," and thought that you might be interested in a plan that has suggested itself to me since attending the Fort Sheridan U S Business Men's Training Camp As I am a graduate of the engineering department of the University of Illinois, where military training is required for two years, I believe that this plan would appeal to students at colleges generally, and it would be a source of great value for the United States Government. Its chief advantages are that it would cost the Government practically nothing and would produce citizenship far superior to what we are able to graduate from our colleges at present.

The plan is as follows A student regiment would be formed at a government post, officered by regular army officers, such as the type detailed now to teach at West Point. The course would continue for one half year, beginning at a semester period and lapping over the summer vacations, students returning to college when finished Such subjects as Civics Military History, Strategy, Military Engineering, Sanitation (mechanical engineers might take a month in a government arsenal shop) etc, would be given under these instructors, as well as thorough discipline and personal hygiene, and also an extended military maneuver under full equipment, in other words, six months of intensive West Point training at Government expense The best graduates of this course would qualify as officers in a volunteer army The regiment would be entirely separate from the regular army and composed entirely of students from various colleges

The college would give one half year's school credit to those completing the course which would be entirely elective and each college would select such subjects to be omitted from graduation requirements in each department as would leave a required course of study which in addition to the army course would produce citizens with equal if not better attainments than those remaining four years in college I would prefer to have the student return to college for an uninterrupted senior year under the collegiate influence making the usual four years from matriculation to graduation

I would be very much pleased to have comments on this plan from citizens in all walks of life

WHARTON CLAY

226 S LaSalle St Chicago Ill

The Steam Automobile

To the Editor of the SCIENTIFIC AMERICAN

An apology is due all drivers of steam cars by you after publishing the 'Winton' article in the automobile number of the SCIENTIFIC AMERICAN All the merits attributed to the steamer it possesses, and a few more and it has not gone on the scrap heap" with the two-cylinder gas car, but has been improved and perfected to such a degree that it now makes 300 miles on a single tank of water and develops 15 miles per gallon of coal oil at 9 cents per gallon instead of using gasoline at 20 cents. It has such flexibility and reserve power that it can pass anything on the road and in ordinary traveling when a gas car appears bobbing up and down hills two or three miles ahead without any extra effort on the part of the steamer, in a very short time the gas car is a thing of the past

I have driven steamers for more than nine years and know what they are, therefore must take exception to the article in question, which is either malicious or ignorance

W DOUDEN

Millersburg, Pa.

How a Rifle Is Sighted

To the Editor of the SCIENTIFIC AMERICAN

I have just read with interest the very good article in your issue of the 11th ult on "How a Rifle Is Sighted," and would like to add a few words thereto with reference to the use of the sight on the Ross rifle, one or two facts in connection with which seem to have been overlooked.

The "U" shaped notch on the battle sight is not of the ordinary "U" shape, but has rather the appearance of a peep sight with a piece scooped out of the top, and was so made with the idea of being used in the same way as the peep sight, i. e., by looking through instead of aiming—while giving the minimum amount of obstruction of view. And I have found, in my experience as musketry instructor, that the recruit will very readily adopt this form of sighting after having had a little practice with the peep. Therefore, the Ross battle sight, when used at close range in a very great hurry, should be quite as accurate as the peep sight would be under similar circumstances.

The peep sight aperture on the Canadian service rifle is no longer of about 6-100 inch diameter, the hole having been enlarged to about 1-10 inch over six months ago, and since this change was made it has proved to be as serviceable as an open sight in the worst kind of light, in addition to its other manifest advantages I have used the tenth inch peep sight on several occasions a considerable time after sunset, when the light was poor, and found the sighting quite as clear as over the bar—which would be no small advatage to a man with poor accommodation of sight.

A. O ANDERSON

Quebec, Canada

Volunteer Motor Boat Squadron

To the Editor of the SCIENTIFIC AMERICAN

You state in your January 1st number, under the article headed "The Motor Boats of the Volunteer Patrol Squadron, that this 'is the first real substantial move of private individuals to train themselves for a naval reserve in this country'

This is contrary to fact as in May 1912 the Power Squadron of the Boston Yacht Club was formed and a fleet of from ten to twenty five power boats held regular maneuvers and drills through the season

This movement spread and in February 1914 under the guidance of Chief Commander Roger Upton, the United States Power Squadrons was formed at a meeting in New York, at which there were representatives from the Navy Department and the Department of Commerce

Since then the squadrons have been formed in Portland, Boston New Bedford Narragansett Bay, New Haven New York, Philadelphia the Potomac River and several on the Great Lakes

The requirement for membership in the squadrons is a high degree of skill in navigation

Frequent drills in the summer are compulsory

This movement antedated all others in the way of preparedness

Although the conditions of service are not as exacting as in the article referred to the number of men participating and its possibilities of usefulness in time of war are at least as great

A squadron may be formed within any recognized yacht club and admitted to the United States Power Squadrons upon its members passing the required examination

FRANK P HUCKINS

Boston Mass

Concerning Leprosy

To the Editor of the SCIENTIFIC AMERICAN

I have read the article appearing under the above heading in your issue of September 4th, 1915 Will you allow me, as a layman to make a few remarks regarding same, as it seems to me somewhat inconsistent concerning both the contagiousness and the cure You say that leprosy has met its Waterloo, would to God it had! But we in South Africa cannot agree with you in that

Chaulmoogra Oil has been used here for very many years, but *we cannot claim that it has definitely cured* a single case of leprosy although many who have used it for a number of years have been discharged from our asylums, still we cannot attribute the cures to Chaulmoogra Oil as most of those discharged were of the anaesthetic type which generally dies out after fifteen or twenty years without any treatment whatever Many other drugs and methods of treatment have been tried here, but we have yet to find the cure Chaulmoogra Oil has been used both internally and externally i e drinking injecting and rubbing the skin So we would very much like to know how it is used in America to produce such happy results

Contagiousness —In several parts of your article you state that the disease is non-contagious, and in others you infer that it is highly so For instance you say "*Once possibly contagious, it is no longer so*" Again "Children may nurse from the breasts of lèper mothers for a year or more, and still be taken away clean and unharmed" And again 'Hence those cities which are now and then thrown into a panic through the report that a leper is at large in their midst need not worry for fear of getting it. Better worry over the case of measles next door" Surely this says plainly that the disease is non-contagious.

In other parts you say 'But when military conquests took us into distant lands where the dread disease exists our medical men at once took up the seemingly hopeless task of finding a cure for it" Which means that you were afraid of the soldiers bringing it home with them Again, you say that, 'In almost all large colonies the lepers are attended by Sisters of Charity, and *these saintly women once their lot is cast,* never again return to the outside world" Why not, if the disease is non-contagious? "A Chinaman first introduced leprosy in Hawaii," and again 'A few of our soldiers returning from service abroad, have brought the disease home with them." Surely these last would plainly say that leprosy is highly contagious Which is it—contagious or not?

Pretoria, Transvaal UNO.

To the Editor of the SCIENTIFIC AMERICAN

Replying to Uno's criticism of my editorial covering leprosy cures as made in American colonies where this disease is prevalent I wish to say that scientists in the Philippines who are industriously studying this disease have asserted many times that it is not ordinarily communicable by contact There is a distinction between infectious diseases and contagious diseases

That cures have not been made in South Africa is no logical argument why cures have not been made in the Philippines On the other hand the Manila press has recorded *additional* cures *since* my article was written, and I have no reason to believe now as I had not before that the papers there are subsidized by an unscrupulous coterie of designing medical men

My critic states that he would very much like to know how Chaulmoogra Oil has been used to produce the happy results recorded *If he will take the trouble* to address the Bureau of Health Manila he may be able to get this information from *official sources*

If this is done it will doubtless be discovered that it is a *matter of record* that children are reared from leprous parents and are afterward permitted to leave the colonies to live among the people

The writer asks *whether the disease* is contagious or not I wish I could say to him that our medical experts who are devoting their time to such work think it is not Furthermore the writer in company with Mr Henry Savage Landor at one time spent many hours in a leper hospital in the Philippines, conversing with scores of lepers and photographing their sores and abrasions We did not contract leprosy as we surely would have had the disease been contagious therefore I might say that I *personally know* the disease *not* to be *contagious* as are measles

I understand that Dr Wayson in Hawaii has effected cures with a new treatment altogether but I am not fully informed on his work and could therefore not discuss it with any degree of intelligence

MONROE WOOLLEY

Fort Casey Washington

Why Not a Lincoln Ironway?

To the Editor of the SCIENTIFIC AMERICAN

The very interesting article in your issue of January 1st by the president of the Lincoln Highway Association prompts the above question

In describing his overland automobile trip the writer refers to the almost impassable state of the celebrated highway *in many places between Chicago* and Nevada during the rainy weather

At such times could not the nearest parallel railroad be induced to run a daily auto special with much profit to itself the autoist and the large towns along its line? Freight rates on a single car added to passenger rates for the autoists, are a big item of expense But a train of ordinary flat cars carrying 30 or 40 autos and their owners should make the cost per auto relatively very small So should the attaching or detaching of two or three such cars to schedule freight trains at different points along the line

And owing to the great saving of time and daily living expense the trip's cost to the ironway traveler must be far less than to the highway traveler The former would make 20 miles an hour while, according to your *correspondent the latter could cover* only 35 miles a day over the soft surface roads of the middle West

By avoiding night travel if preferred, and keeping to the speed just mentioned the autoists would see every mile of the country They would be no more exposed to wind and weather on the train than on the road less so in fact than while ploughing through "gumbo mud or jolting and plunging into the chuck holes or 'Thanky Marms' farther west—and frequently *alighting to extricate their cars*

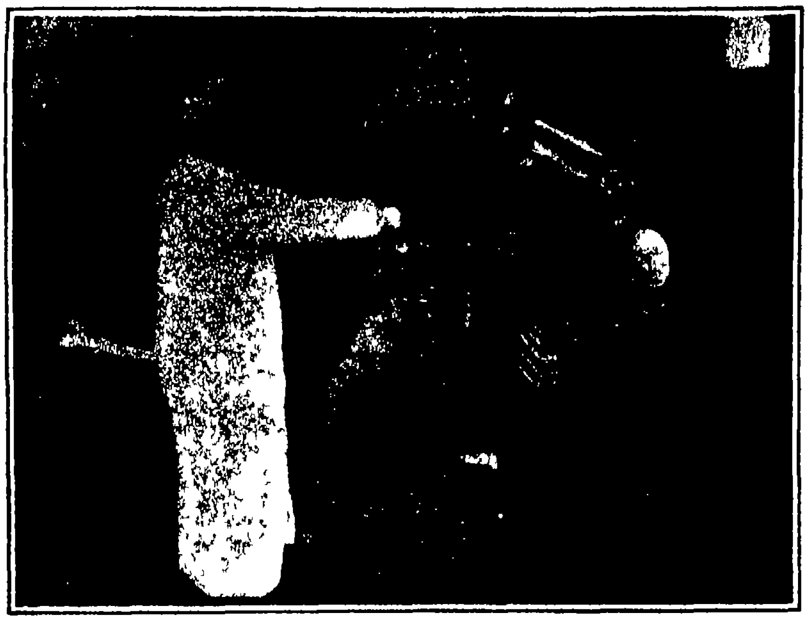
The president of the Highway Association owing to his name or nature had something of a joy ride Yet he confesses to a very long and a very strenuous one Five thousand others he thinks essayed the trip in whole or part but he cannot be sure that any of them got through Probably the proportion was decidedly small

How many of the 5,000 might have made it however could they have had a lift of from 50 to 250 miles or more whenever the weather became too execrable?

For auto tours Europe is out of the question next summer and will be a sorry place for some years to come Meanwhile the West needs the autos and the autos need the West Must they await the hard surfacing of many hundred miles before they can get together?

JOHN CHETWOOD.

San Francisco, Cal



Taking a blood test of a horse

Horses operated on at the withers

A Horses' Hospital

Work of the German Army Veterinary Surgeons

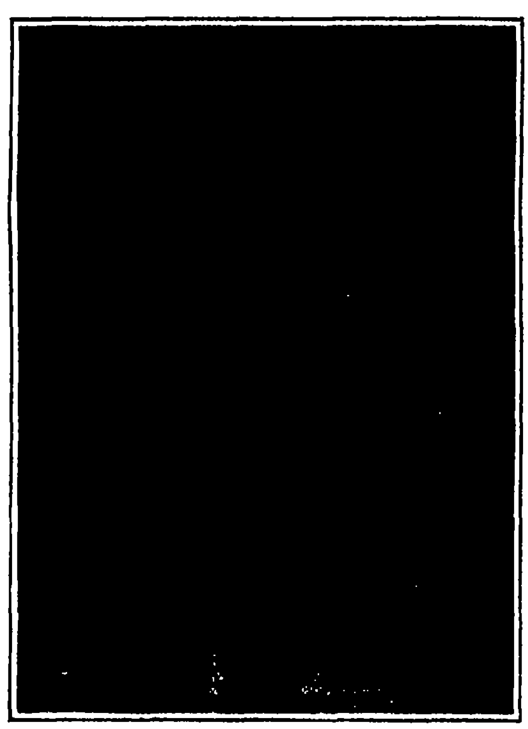
By Dr. Alfred Gradenwitz

IN spite of the growing importance of motor cars and the prominent part incumbent on railways, ours is by no means a horseless age. In fact, the present war, while evidencing the wonderful mechanical progress of our era throws the horse into unexpected prominence. When it is considered that each army corps, on a war footing, comprises tens of thousands of horses, it will be readily understood that the total number of those used by all belligerents should amount to some millions. The veterinary service for these quadruped armies therefore raises a number of problems and assumes an unprecedented importance, second only to sanitation in wartime.

How are the horses wounded on the battlefield or affected with illness restored to health and made fit to resume their posts? Little has so far been heard of the way this important task is organized and it is thought that the following account will be all the more welcome.

In order, first, to sum up the main tasks performed by the veterinary surgeon, behind the battle front it may be said that by staying the bleeding of recent wounds, he is able to save the life of a great many horses. Again, in the case of epidemics, he will have to diagnose the complaint and to take such measures as are required in order to remove the infected animals. The discovery of glanders may even be called a vital question for the army, this terrible disease being transferable to man, even though the epidermis be intact. Any horses responding to the Malleine test are, therefore, killed and dissected immediately, thus controlling the disease and insuring the maintenance of sufficient numbers of these animals.

The treatment of wounded and sick horses, then takes place at special veterinary hospitals which have, for the first time, been installed during the present war. The writer is indebted to Veterinary Surgeon Major Ohm and Major von Papen the medical and military directors respectively of the Insterburg Veterinary Hospital, for the pictures accompanying this article and for much of the information it is based upon.



Horse undergoing Salvarsan treatment

This hospital, at the end of November last, was created, as it were out of nothing, and had to fulfill a most difficult task about 140 diseased horses, many of whom were affected with glanders, being transferred to it at the very beginning. The barracks occupied by the hospital, after being vacated by their regiment, had been taken up, in succession, by fugitives from Eastern Prussia, mounted Russian troops (during an invasion lasting but a few days but leaving its traces of reckless devastation), and, finally again by fugitives. On being taken over by the cavalry division, the barracks were found in an almost incredible state of neglect, and had to be cleared and disinfected most thoroughly with the assistance of Russian prisoners, before the hospital could commence operation. Rooms for accommodating patients of widely different kinds were made ready, and the hospital now comprises the following departments:

1. The reception stable, accommodating 60 horses, where all the horses coming from the front are kept until received in the proper ward. Here they are submitted to the Malleine test, as well as to blood tests, the result of which is waited before any horse is allowed to leave this stable.
2. A stable for patients suffering from infectious lung diseases, which affords room for 80 horses. This, at the present moment, is used for surgical patients, there being no cases of lung disease.
3. A shed comprising several sections, respectively, for horses suffering from glanders, suspected of infection with glanders, and afflicted with mange.
4. Three stables for surgical patients, accommodating 140, 140 and 80 horses, respectively.
5. A stable for officers' horses, mares in foal, and mares and foals, as well as for cured horses, ready to be released.

(Concluded on page 132)

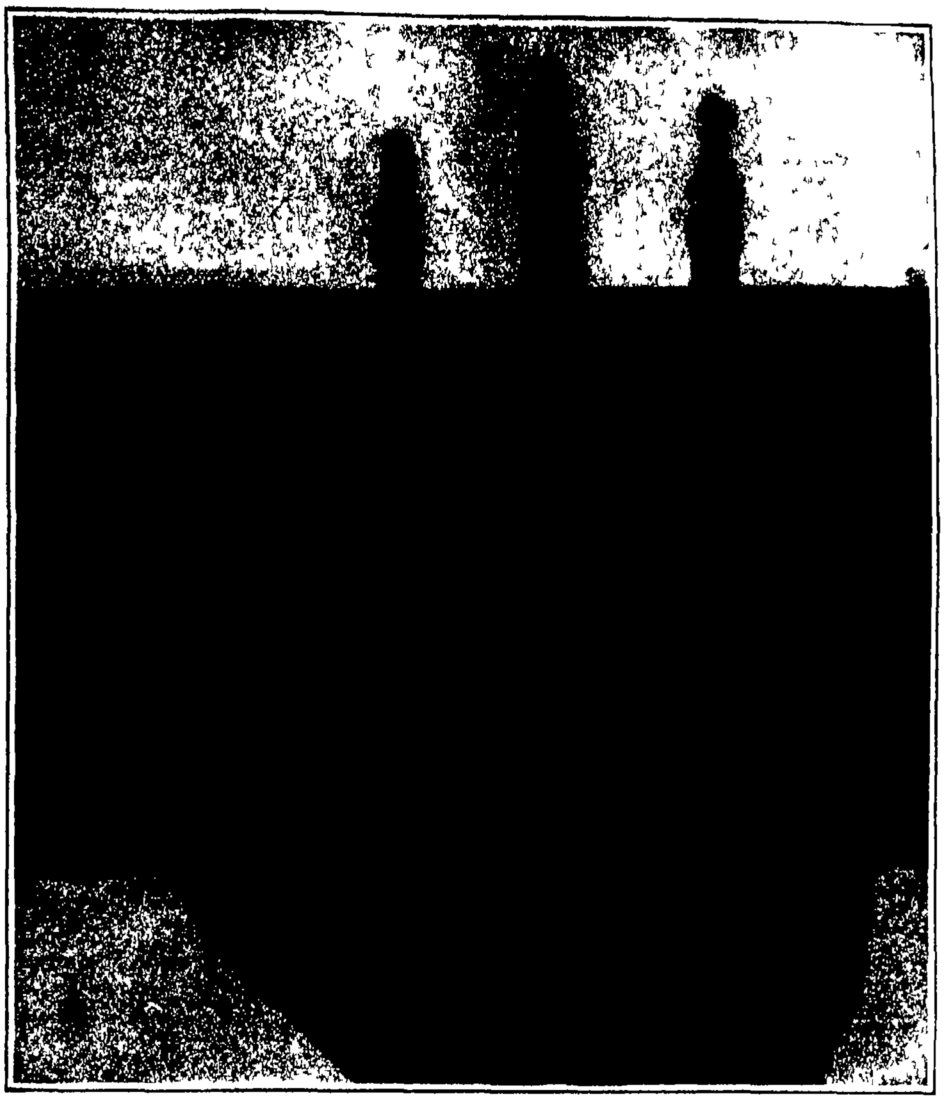
Removing the shoes from a horse

Horse in a sling to relieve weight on an injured leg

An Improvement in X-Ray Photography for Legal Purposes

IN fifteen states of the Union to-day, X-ray photographs or radiographs are not admitted as legal evidence in court, unless the plates or prints include a label on which is written the name, address, date, remarks and other information relative to the case, over which appears plainly the part presented for damages. Obviously, the label or card must be partially transparent, leaving a more or less distinct view of the injured member showing through.

The method heretofore employed for attaining the transparent data sheet in radiographs consists of a celluloid container, sometimes lettered with the operators' names, into which lead letters and figures mounted on celluloid plates can be inserted By altering the letters and figures it is possible to secure any desired combination in the legend appearing in the radiograph. While this method serves the purpose intended, still, it presents two objections first, the lead letters have to be placed adjacent to the object being photographed, with the result that the letters often are displaced or moved out of alinement, resulting in an unsatisfactory—from a legal standpoint—radiograph, second, the very nature of the letters used limits the amount of information that can be registered on the negative.



Typical radiograph intended as legal evidence, showing the use of the newly invented tinfoil radiograph label on which the necessary information has been typewritten

There recently has appeared a new method of identifying radiographs, which, although of utmost simplicity, appears to have solved the existing objections. Invented by Dr Aurelius de Yoanna, of Brooklyn, N Y, it consists essentially of taking advantage of the variation in thickness of a piece of very thin sheet lead or so-called tinfoil," which results when writing on it with either a lead pencil or other stylus. As shown in the accompanying illustration, all the desired information may be written by hand or even typewritten on a sheet of tinfoil which is then applied to the hand or other injured member, by any suitable means such as glue or adhesive tape Due to the fact that the thinned or compressed portions of the tinfoil offer less resistance to the passage of the X rays than the remainder of the sheet, it is obvious that such portions will be lighter and stand out prominently in the radiograph On the other hand, the uniform thinness of the tinfoil sheet permits of showing the superimposed member through it. Thus are the legal requirements met with in a simple manner and without necessitating any special apparatus other than a tinfoil radiograph label and an ordinary pencil or similar stylus.

Portable High Frequency Oscillator for Testing Purposes

AMONG the more recent electrical testing apparatus is a portable, high frequency oscillator designed especially for the testing of porcelain, high tension line insulators and bushings. It is made in different types and voltages, among the latter being 100,000, 125,000, 250,000 and 500 000 volts. The 125,000-volt type of equipment will deliver current having frequencies of approximately 300,000 cycles at voltages up to about 165,000.

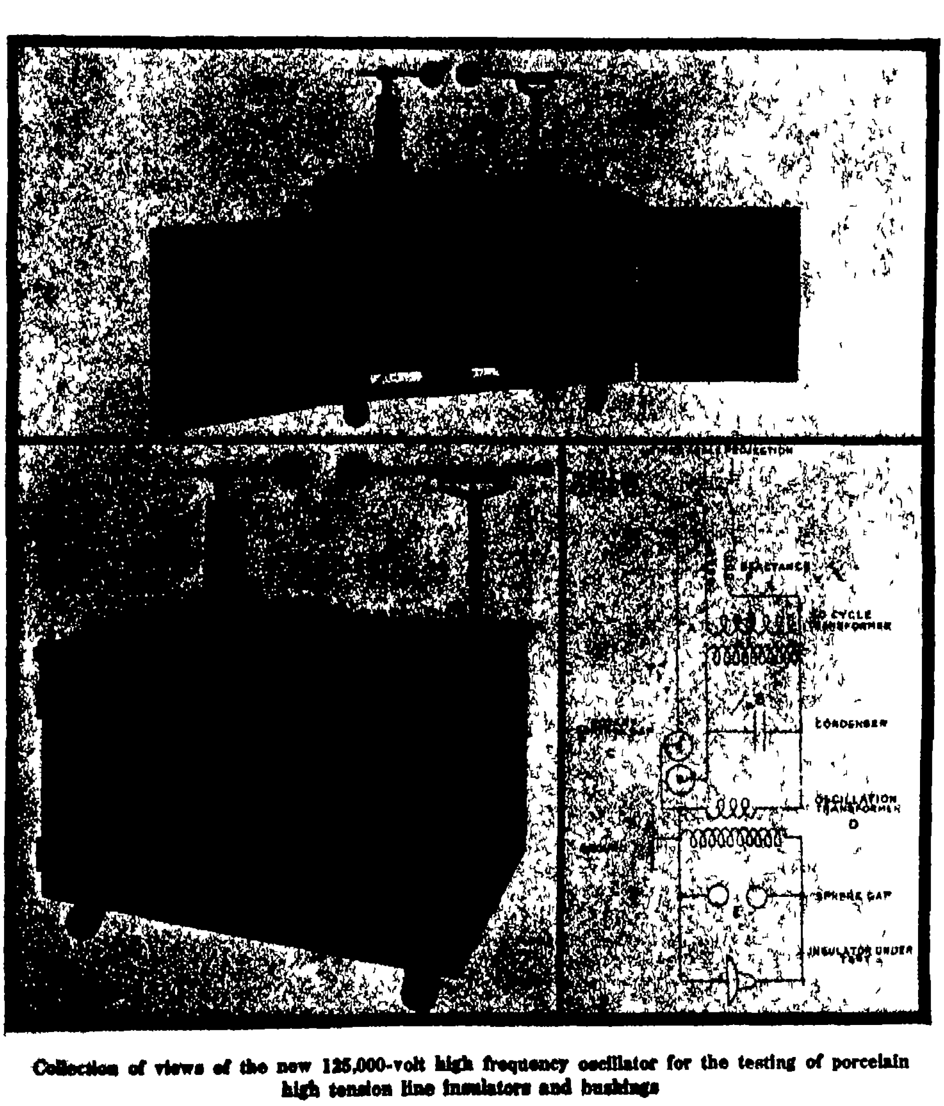
The function of the high frequency oscillator is to approximate the conditions under which insulators fail in service, prime among which being lightning surges, switching surges and arcing grounds. It is designed for testing porcelain insulators only and is best adapted to testing at the factory laboratory or at some point on a transmission system where insulators are delivered or tested The essential elements of the high frequency oscillator are briefly A step-up transformer which raises 110 or 220 volt primary current to 13,000 volts in the secondary, a condenser placed across the terminals of the high voltage coils of this transformer an adjustable control gap an oscillation transformer oil immersed with an iron core, consisting of a few turns on the primary and many turns on the secondary a properly proportioned sphere gap and a suitable reactance to protect the step up transformer against the damaging effect of short circuit when a spark takes place at the control gap

The oscillating current transformer of the testing equipment consists of two concentric windings arranged vertically in a stoneware jar and immersed in oil This, as well as the other apparatus comprising the equipment is supported in an angle iron frame mounted on casters and enclosed on all sides with perforated iron A wooden cover is placed on top and supports the sphere gap

The voltage of the equipment is controlled by gradually opening the control gap one electrode being grounded and connected to a rod extending through the side of the case, which permits manipulation while the arc is playing across the gap. The high potential across the sphere gap is read directly in volts.

Heretofore, the usual high potential test of an insulator has been to apply twice its rated voltage at 60 cycles for one minute However, it has been found that insulators that have successfully passed such a test while they never fail in practice when subjected to 60-cycle currents of voltages within the rating, are damaged electrically by lightning by heavy surges from switching by heavy surges from arcing grounds and similar causes In marked contrast, however when high frequency current is applied in the tests, the whole insulator is bathed in a visible and audible corona, which clings closely to the surface and searches more thoroughly for flaws and can be extended almost to the edge of the skirts before the spark discharge takes place This spark then extinguishes itself and relieves the stress in that particular location, whereupon a new spark is formed elsewhere on the insulator surface. One hundred and twenty sparks per second can thus be produced which is equivalent to 120 separate tests with a 60-cycle outfit The heating effect produced by the corona discharges is negligible, and while the heat generated from sparks is naturally greater, still it causes a rise of but a few degrees

In conclusion the thoroughness of the high frequency test of insulators is strikingly illustrated by the following results Among 1 000 porcelain parts of different types tested by each method, no failure by the 60-cycle test was noted on any part that had undergone the high frequency test On the contrary, there was an average of 8 per cent of failures as the result of the application of high frequency current after the insulators had successfully withstood the 60-cycle test, indicating that the former furnishes a more exacting trial.



Collection of views of the new 125,000-volt high frequency oscillator for the testing of porcelain high tension line insulators and bushings

Above: Interior view of the apparatus. At the left: General view of the high frequency oscillator At the right: Diagram of connections of the apparatus, showing the electrical relationship of the various members

Strategic Moves of the War, January 20th, 1916

By Our Military Expert

THE failure of the Entente Allies properly to fortify and defend Mt Lovcen the towering buttress of Montenegro which dominates not only the capital of that midget kingdom but the great Austrian naval base at Cattaro, seems on the face of events, almost inexcusable Winding a devious way between frowning crags and lofty mountains the Bocche di Cattaro forms a quiet secluded roadstead in which a gigantic fleet may rest secure from assault, provided the surrounding eminences are free from hostile, and adequate, occupation

As a line for military operations, the Montenegrin Austrian frontier in this section is practically useless, on account of the rugged character of the country and the almost total absence of roads over which an army may operate but possession of the section available for secure utilization of the Cattaro naval base means that unless the Austrian fleet is foolhardy enough to venture forth to give battle to greatly superior forces, it may lie snugly in the mined roadstead at will, while otherwise it might have been shelled out with comparatively few guns of major calibre, and the place be rendered untenable

It should have taken very few troops and a minimum of material to have secured the position had effort been made in this direction while there was yet time It simmers down in public opinion generally to another blunder of omission chargeable to the loose confederation of Entente alliance

Should Montenegro conclude a separate peace with the Central Empires (at present writing reports are somewhat conflicting on this point), the country in question may do so on the ground of not having been signatory to the agreement to wage the war to a conclusion regardless of local conditions It would include the surrender of all Montenegrin troops thus vitiating the effectiveness such as it is of about thirty or forty thousand rough troops, poorly equipped poorly armed and poorly, yet valiantly, led It would release for use elsewhere at least twice the number of Austrian troops, approximately two army corps minus such portion as would be retained in the vicinity to police the surrendered territory and guard against a counter movement

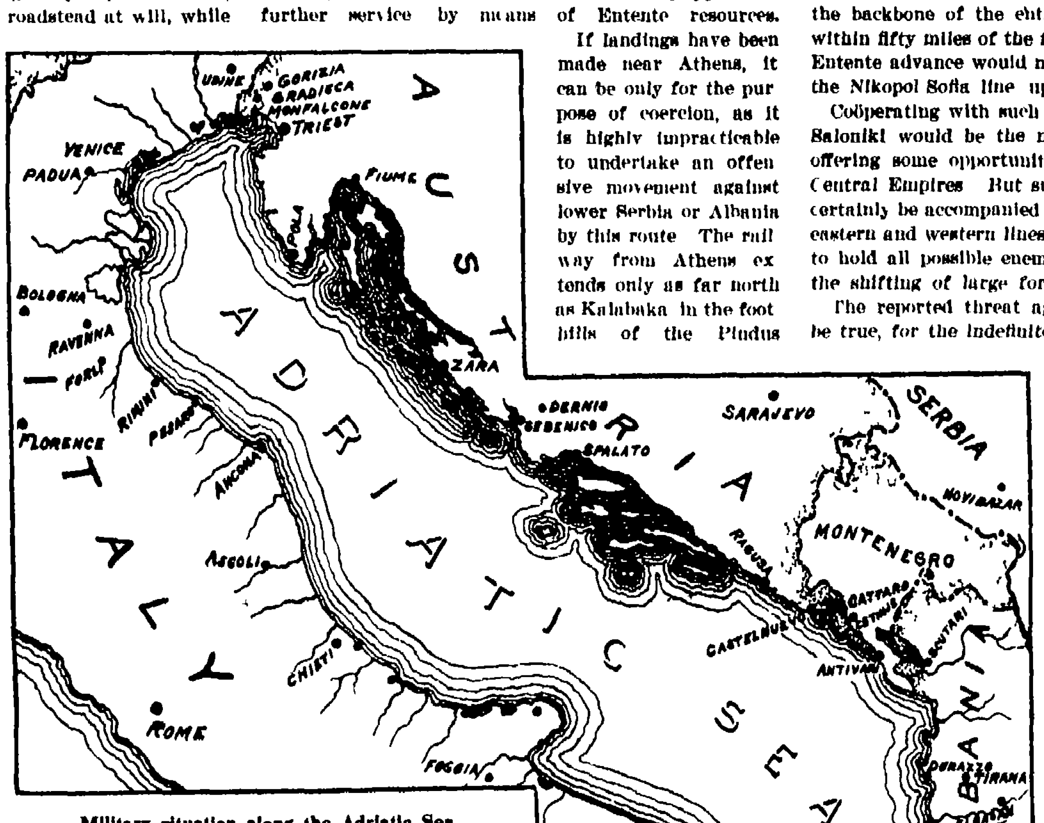
In such a case Italy would just as well withdraw all her forces which may have been landed in Montenegro and Albania This latter country is about as destitute of roads as the former and its terrain is equally forbidding The attempt to administer a strong flank attack upon the Teutonic forces in Serbia through this section would be attended by such difficulties that much better results would accrue even at greater loss in battle through direct attack from Saloniki in ample force

Italy may reasonably withdraw and concentrate her efforts along her Austrian battle-line, or add to the Entente strength at Saloniki The ultimate effect upon these Adriatic principalities would amount to as much as would attend their occupation if through the efforts of the Entente victory eventually ensues to the cause The negotiations would then certainly include restoration of Montenegro and Albania and the Entente would have been the gainer by the lessening of the front to be occupied during the war Sentimental reasons may have dictated the sending of troops to this section in the first place they are certainly useless there now

For months Italy has been hammering at the Austrian line apparently with little success From the nature of the ground it is a task Herculean which Italy has undertaken yet it would seem that with Austrian forces necessarily divided and with principal activity elsewhere so far as numbers go Italy's resources should have forced a passage ere now The anomalous situation wherein Italy is declaredly at war with Austria while Austria's dominating ally Germany is not officially included is peculiar, to say the least Correspondents who have been in Italy recently report that things German are by no means taboo there, and that the internal situation has no likeness to that in other countries of the Entente with regard to people, customs and activities of their enemies.

This has led observers to deduce that Italy has only her own immediate ax to grind and would be content to wrest her personal gains from Austria without further concern with the war The signing of Italy to the "Fight to the End" treaty, seems to disprove this, but certainly there is something strange in the matter

The reported landing of Entente forces at various Grecian points other than Saloniki and Orphani, upon which latter place the Entente right is supposed to rest, leads to much speculation as to the truth of the report and the object of the move Piraeus and Phaleron, Athenian seaports, it is stated are now occupied by Entente forces of unknown strength, while the island of Corfu separated from the Albanian Grecian frontier by a guarding strait, has become a veritable island of regeneration for the war worn Serbian forces which, it is alleged will be reorganized and reëquipped for further service by means of Entente resources.



Military situation along the Adriatic Sea

If landings have been made near Athens, it can be only for the purpose of coercion, as it is highly impracticable to undertake an offensive movement against lower Serbia or Albania by this route The railway from Athens extends only as far north as Kalabaka in the foothills of the Pindus mountains which establish a frowning barrier to further free advance although there are a number of roads which thread a way northward. The other branch of the Athenian railway finds a terminus at Symora, on the western shore of the Gulf of Saloniki As a railway from Saloniki extends westward by devious way toward Monastir, the same ultimate ground is tapped by a shorter line

Of course it is not impossible that a military movement be undertaken through Thessaly but there seems to exist no necessity for it

The condition of Montenegro and the practical clearing of Albania or that portion of it which offers any threat to Teutonic communications or flank, seem to clear up the situation to a certain extent, to simplify it by the reduction of extent of the battle lines. Something must occur before long, for it is unreasonable to believe that the Central Empires are willing or able to retain a large force, even if it is principally composed of Bulgar and Turk, inactive. At the present moment Saloniki is able to report "We are holding them off," while Teutonia is equally justified in saying "We are holding them in" It is a fair statement from either side but no immediate advantage accrues to either Teuton or Entente as things now are.

The mere fact that the Entente persists in holding on at the Grecian seaport is sufficient to demonstrate that there is a purpose behind it, which, in all probability resolves itself into the possession of an adequate base for an offensive when conditions become ripe, if they ever do While the Russian offensive seems to have momentarily slackened there is every reason why an attempt should be made to force home the clearing of Bukowina that province which Roumania regards as her own and desires mightily Without doubt, it is part of the price Russia has agreed to pay for active Roumanian support, even though it is purchasing with the property of another With this Austrian province controlled to the Carpathians, with a general bracing of Russian strength, it is not inconceivable that Roumania would at once take heart and throw in her lot with the Entente cause.

Should that become an accomplished fact, the occupation of Saloniki would be fully vindicated. Russian and Roumanian troops would certainly strike southward against Bulgaria, along the five great railway lines of Roumania while the western frontier of that country is well guarded by the Transylvanian Alps, which form its boundary, being touched at only six points by railways in a distance of some four hundred miles, and of the six railways, only four penetrate the frontier

With Roumania in the game, the railway line which connects the Central Empires with Turkey and the East, the backbone of the entire Balkan theatre of war, is within fifty miles of the frontier, although any probable Entente advance would necessarily strike directly down the Nikopol Sofia line upon the latter city

Coöperating with such a movement, an advance from Saloniki would be the natural sequence, even though offering some opportunity for defeat in detail by the Central Empires But such a movement would almost certainly be accompanied by demonstrations on the main eastern and western lines, Russia, France and Flanders to hold all possible enemy troops in place and prevent the shifting of large forces to meet the crisis

The reported threat against Greece, then, may well be true, for the indefinite position of that monarchy is a sore trial to both contending parties. Force may have been utilized to supplement the diplomacy which has so signally failed in Balkan situations of the past when applied by the Entente Perhaps there is a new diplomacy emerged from the crucible of failure It is certain that the Entente would be in better case even if Greece should actively declare against the coalition than it is at present where a policy of gloved handling handicaps decisive action.

It is believed by observers generally that the preponderance of the Greek population is inclined to favor the Entente cause. A Teutonic queen, a perplexed king a populace fearing the wrath of Germany's mighty vengeance in case of failure, constitute a situation wherein the Gordian knot must be cut by no uncertain hand, and that, soon

Should the present Grecian administration be overthrown and a republic under Venizelos be established, a possibility which is indicated in dispatches, the probability of Grecian forces taking the field with the Entente is considerable Such additional strength should go far toward permitting an advance from the Saloniki lines and precipitate an action of the first magnitude, which might have a decisive bearing upon the conclusion of the war if only by restricting the warring lines to the old east and-west fronts in case local victory resulted for the Entente

If the Teutonic attack upon Saloniki takes place within a short time, as is reported in contemplation and if Bulgarian and Turkish troops participate actively, it may in itself bring Greece into the fight in defense of the integrity of the land

Microstructural Changes in Annealed Bronze

THE United States Bureau of Standards has just completed a study of the annealing of bronze, using the commercially important alloy zinc bronze (copper 88 tin 10, zinc 2) as a type. The results indicate that bronze is very different in its behavior from steel It shows no recrystallization or grain refining unless it has been previously cold worked, as by rolling or hammering

Heretofore, there has existed a general belief among metal workers that cast brasses and bronzes, not unlike cast steel, were greatly improved as a result of refining the grain by proper annealing.

The Heavens in February, 1916

Our Interesting Neighbor, Mars

By Prof. Henry Norris Russell, Ph. D.

NEXT to the solar eclipse of February 3rd—which was fully described in our last article—the most interesting event of the present month is the opposition of Mars, which occurs on the 9th

The ruddy planet is at this time in the constellation Leo, about 18 deg north of the celestial equator and, so far as his position in the heavens goes, very favorably placed for observation. As regards his distance from us, however, the present opposition is far from favorable—the closest approach of the two planets, on the day preceding the opposition, being 62,500,000 miles.

The orbit of Mars is decidedly elliptical, so that, though his mean distance from the sun is 141,000,000 miles, his greatest distance is 154,000,000, and his least only 128,000,000 The Earth's orbit is much more nearly circular, the greatest distance from the sun being 94,500,000 miles, and the least 91,500,000, and the two orbits are so disposed in space that the aphelion of the Earth—its remotest point from the sun and the perihelion of Mars—its nearest point to the sun—are nearly opposite to one another If, therefore, the Earth passes between the sun and Mars at the time when Mars is in perihelion, the distance of the two planets is only 34,500,000 miles—the smallest possible value Such a "favorable opposition" always occurs in the latter part of August, for it is at this time every year that the Earth reaches the appropriate point in her orbit.

At a February opposition, on the contrary, Mars is near his aphelion and more than 60 000 000 miles outside the Earth's orbit—the present month furnishing an almost perfect example

Since it takes the Earth a little more than two years to catch up with Mars, each successive opposition comes some 50 deg farther east in longitude than the last, and the point of opposition works slowly round the sun, taking about 16 years to complete a circuit. Favorable oppositions therefore come at intervals of 15 or 17 years. The last one was in 1909, and the next—an unusually good one—will happen in 1924 After one of these dates the oppositions are successively less favorable for some eight years, and then gradually improve again.

At the present time Mars shows a telescopic disk a little less than 15 inches in diameter and appears to the eye like a star of magnitude—1.0—that is, three times as bright as Capella, and about 60 per cent as bright as Sirius At a favorable opposition his diameter is fully 25 inches, and his magnitude is -2 7, making him nearly three times as bright as Sirius, and nearly five times his present brightness

There are, however, certain observations for which the present opposition is valuable, for it is now summer in the northern hemisphere of Mars, and his northern temperate and polar regions are turned toward the sun, and are therefore visible, while the south pole is turned away and is invisible At the favorable oppositions the reverse is the case The south polar regions, and indeed the southern hemisphere generally can then be well studied, but the northern regions must wait for occasions like the present.

The possessor of a small telescope, though he may be disappointed in the small apparent size which Mars presents, can nevertheless see things of real interest, the darker areas which spot the generally ruddy surface, and the conspicuous white polar cap, shrinking as the Martian summer advances. The finer details, and notably the much discussed "canals," can, of course, only be seen with instruments of very high power

The present Martian season is about half way from the vernal equinox toward the summer solstice, corresponding to the beginning of May on the earth The polar cap is large, and shrinking rapidly, while, according to Dr. Lowell's latest bulletin, the northern canals are prominent, and the southern faint.

The Heavens

As our map shows the finest region of the evening sky is now in the southwest. Right overhead are the twin stars of Gemini, Castor and Pollux—the former white, and a fine telescope pair, the latter yellow and single. South of them is the still brighter star Procyon, in Canis Minor, while nearer, and to the southwest is the planet Saturn which is brighter than any of these three stars

Lower down, in the south, is Sirius, brightest of all, with the remaining stars of Canis Major below and to the left Southwest and a little higher, is Orion the finest group in the sky, and to the right of this, almost due west, is Taurus.

Northwest of the zenith is Auriga, with the brilliant Capella second only to Sirius among the stars now in sight, while Perseus is lower down and Cassiopeia still lower, and to the right

Just north of east below the Pole are Draco and Ursa Major, rising toward the meridian Below, a little north of east Bootes has just risen and most of Virgo is also in sight a little farther south Leo is high in the east, bearing Mars like a ball of fire in his fore paws while Hydra, whose head is southeast of the zenith, trails downward to and below the horizon.

The Planets

Mercury which was an evening star last month, passes between us and the sun—though considerably north of the direct line—on the 5th, and becomes a morning star He will be well visible at the end of the month and reaches his greatest elongation on March 1st when he is 27 deg east of the sun, and rises about 5 30 A M

Venus is an evening star growing brighter as she approaches the Earth and more conspicuous as she gets farther north Telescopically, she shows a gibbous phase like the moon, four or five days from the full To the naked eye, the most notable event will be the conjunction with Jupiter on the evening of the 13th. The two planets are then only four tenths of a degree apart, and will form a very striking spectacle on account of their great brilliancy Venus appears nearly two magnitudes brighter than Jupiter—that is, about six times as bright Nevertheless, when viewed telescopically, Jupiter will be found to appear of more than twice the apparent diameter of Venus, and more than five times her "angular area," even if the whole disk of Venus were visible As only a little more than three quarters of the illuminated surface of Venus is visible, the actual ratio of the angular areas of the two planets is seven to one in favor of Jupiter It follows that, for equal apparent areas, the surface of Venus appears to be more than forty times as bright as that of Jupiter The reason for this is obvious Jupiter is 460,000,000 miles from the sun, and Venus only 67,000,000 The intensity of the sun's light varies inversely as the square of the distance, so that Jupiter, per square mile, gets only one forty-seventh as much light as Venus does, and, if the actual reflecting power of their surfaces were the same, the brightness of parts of the two planets of the same apparent size would be in this ratio

When allowance is made for the fact that part of the visible surface of Venus is not fully illuminated by the sun, it is found that the reflecting power or "albedo" of the surfaces of the two planets is very nearly the same,—59 per cent for Venus and 56 per cent for Jupiter

Mars is in opposition, as already described and moves from Leo into Cancer during the month He is visible all night long, and is by far the most prominent object in the eastern sky Jupiter is an evening star setting at 8 20 P M on the 15th and visible, even before sunset if one knows just where to look Saturn is in Gemini, coming to the meridian about 9 P M, and very well placed for observation.

Uranus is in conjunction with the sun on the 5th, and is quite invisible.

Neptune is just past opposition—his position on February 2d being R A. 8h 12m 31s Declination +19° 49′ 11″, and on March 1st 8h 9m 41s +19° 48′ 32″ This places him about 1° 50′ north, and from 1° 15′ to 40′ east of the triple star Zeta Cancri which itself is at the apex of a right angled isosceles triangle whose acute angles fall on β and δ Cancer (shown on our map) To identify the planet without a detailed star map it will be necessary to make a sketch of the faint star in the region and watch for the planet's motion He is of magnitude 7 7 -quite invisible to the naked eye—but can be seen with a good field glass

The moon is new at 11 A M on February 3d in her first quarter at 5 P M on the 10th full at 9 P M on the 18th, and in her last quarter at 1 A M on the 26th She is nearest the Earth on the 1st remotest on the 13th, and reaches her nearest point (perigee) once more on the 29th On the 3d she eclipses the sun, the eclipse being partial for the eastern United States, and lasting from about 10 A M to noon She is also in conjunction with Uranus and Mercury on this day both being very near the sun—with Venus on the 6th Jupiter on the 7th Saturn on the 15th Neptune on the 16th, and Mars on the 18th

Princeton University Observatory,
January 18th, 1916

At 9 o'clock Feb 6.
At 8½ o'clock Feb 14
At 8 o'clock Feb 21

At 9 o'clock Mar 8
At 8½ o'clock Mar 16
At 8 o'clock Mar 23

At 9½ o'clock March 1

NIGHT SKY FEBRUARY AND MARCH

The Current Supplement

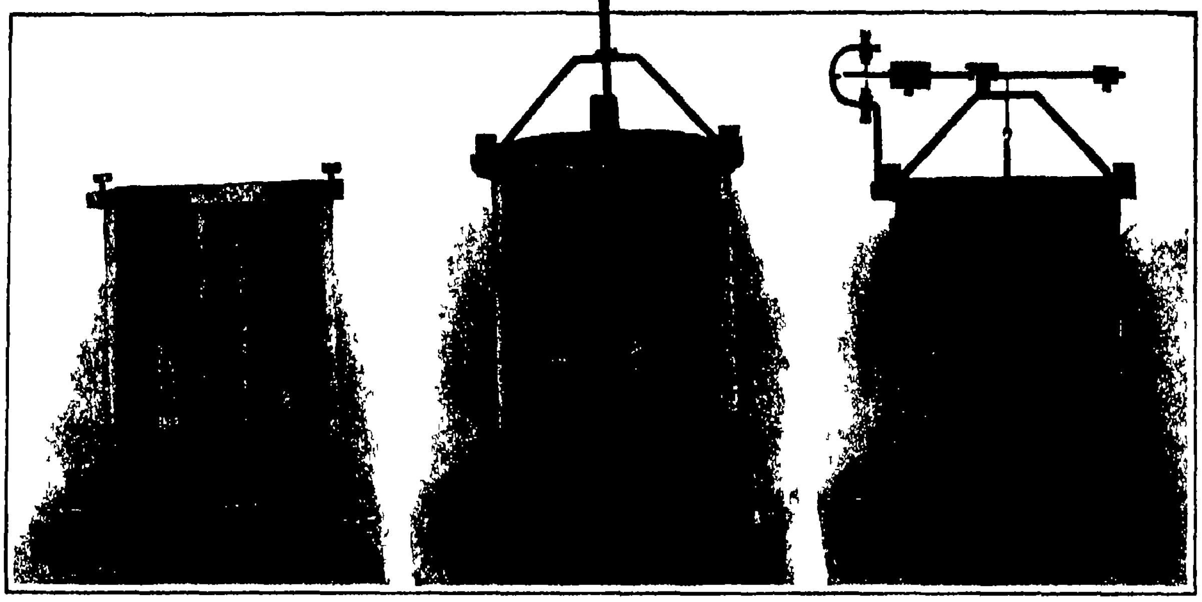
AN article on *The Construction of the Heavens* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, of January 29th, No 2091 is an unusually readable survey of the progress of sidereal astronomy *The Destruction of Historic Edifices in Europe* gives a few facts in regard to the irreparable injuries that have been inflicted on many famous public buildings. There are some pictures showing attempts at protecting the exterior decorations *Searchlights in War* tells about some of the later and large electric outfits, and their various uses. The article is accompanied by excellent descriptive illustrations An important paper at this time is the one on *Our Merchant Marine* that reviews its past history and future possibilities In view of the proposals to establish government research laboratories the illustrated description of *The U S Naval Engineering Experiment Station at Annapolis* is timely, for comparatively few people are aware of what has already been done in this direction *By-products of Gas Manufacture* gives notes on the recovery of hydrocyanic acid and its applications *An Ingenious Electric Drive Gear* describes the operating mechanism of a gasoline motor car for use on branch line railways a problem that is attracting attention in transportation circles It is accompanied by several illustrations of the mechanism employed *Zeppelin Airships* is a descriptive and historical address by the designer of these monsters of the air, together with some discussion of the subject There are several appropriate illustrations. *Oil-Mixed Portland Cement Concrete* gives useful information in regard to the preparation and use of a valuable building material The paper on *The Improvement of the High Boiling Petroleum Oils* is concluded There are also several shorter articles of general interest.

Apparatus for Demonstrating the Motion of Gas Molecules

MUCH credit is due Dr Edwin F Northrup of the Palmer Physical Laboratory, Princeton University Princeton N J, for developing what is believed to be the first mechanical apparatus ever designed for fully and successfully illustrating in a visible way the motion of gas molecules and the principles which govern these motions as laid down in the kinetic theory of gases, and for the verification of some of the theorems of this theory with quantitative measurements

The apparatus consists essentially of a circular metal base supported on three legs provided with leveling screws on which rests a glass cylinder with open ends The glass cylinder is approximately 25 cms high and 22 cms. in diameter A metal ring rests upon the top of the glass cylinder Various attachments can be made to this ring When the apparatus is used for illustrating the motions of gas molecules and the pressure produced on the walls of the container by molecular impact, there is suspended from a cross piece attached to the metal ring a floating disk of glass This glass disk is capable of free motion, in the manner of a piston head within the glass cylinder The glass disk is ordinarily located a little above midway between the bottom and top of the glass cylinder In the volume enclosed by the glass cylinder between the base piece and the floating glass disk approximately 16 000 steel balls of 1 16-inch diameter are maintained in motion in the manner of gas molecules. The distribution of the balls throughout the volume in which they move is perfectly uniform The motion of the balls is produced by means of four metal rotors which rest upon the metal base and rotate in the horizontal plane, two of them rotating in a clockwise and two in an anti-clockwise direction The impact given the steel balls by the revolving rotors causes them to be in constant motion simulating the action of gas molecules Power for driving the rotors is derived from a small electric motor Underneath the steel plate of the apparatus are four intermeshing gear wheels and a pulley for belt attachment to the motor

The Northrup visible molecules apparatus, as it is termed together with its accessories is designed to illustrate in a striking and convincing manner the following fundamental properties of a nearly perfect gas First —The change of pressure of a gas when the volume is maintained constant and the pressure changes Second —The change of volume of a gas at constant pressure with change of temperature Third —The property known as the viscosity of a gas—a property which is exhibited in all gases when the oscillations of an oscillating system suspended in a gas are damped out Fourth —The property possessed by a gas (and a liquid) of causing the irregular motion of small particles suspended in the fluid, known as Brownian movements In the accompanying illustrations the accessories required for the different demonstrations as well as the method of arranging the apparatus are shown

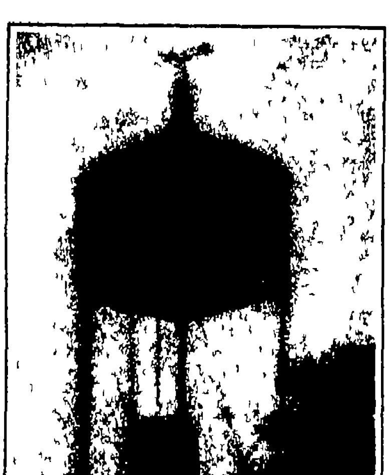


Visible molecules apparatus developed by Dr Northrup, arranged for different demonstrations of the principles of gas molecules

At the left Apparatus arranged with suspended wooden balls for illustrating the Brownian movements. Center: Set up of the apparatus with steel disk rod and iron hub for illustrating viscosity of a gas. At the right Apparatus assembled to illustrate and demonstrate changes in pressure at constant volume, of a gas, when the temperature changes.

Unique Sleeping Room Reached by One-Passenger Elevator

THE city engineer of a small town in California, who desired to spend his sleeping hours above the sultry air of his bed room, hit upon the ingenious scheme of building an elevated sleeping apartment, far enough above the ground so that there would be a noticeable change in the temperature and the purity of the air The net result of his efforts is veritably a nest in an iron tree, for he erected four stout iron pipes, braced them securely and built a comfortable sleeping room at the top The distance between the floor is nearly 40 feet, and it is safe in all weather Its builder estimates that it will withstand a 200 mile-an-hour hurricane with ease Aside from the principle of the idea itself, probably the most unique feature is the means for reaching the lofty sleeping room A small, box like elevator, guided by a two-inch galvanized iron pipe is lifted by the strength of a one-sixth horse-power electric motor Screens enclose two ends of the house so that the ventilation nearly approaches that to be had by sleeping in the open on the hill top



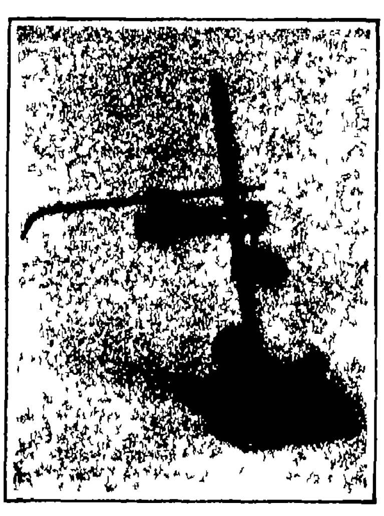
Elevated sleeping apartment built by California engineer

Electric Test Indicator for Surface Gage

TO eliminate the strain on the eyes which accompanies the employment of an ordinary surface gage used by machinists and toolmakers, there has been devised an electric test indicator of simple design

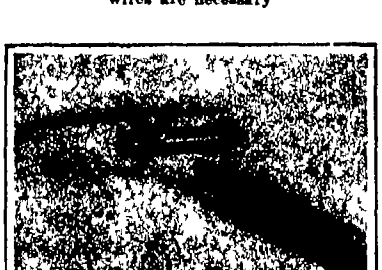
The device which is shown in the accompanying illustrations, is the invention of J G Xander of Reading, Pa It consists of a main body containing the battery and electric bulb, a gaging needle and the holding member There are no connecting wires, and in every other respect the instrument is self-contained. The dry battery is renewable at small expense, its life being more or less problematical since it depends entirely on the service to which the indicator is put. The inventor states that he has used an indicator daily for over three months before renewal of the battery became necessary, and this may be considered a fair average.

In use, the electric test indicator is applied in the same manner as the usual gages, but instead of watching the contact of the needle of the surface gage with the work being trued up in any machine tool, the workman is only obliged to watch for the flash of the electric lamp. The moment the ball point of the needle touches the highest point of the work in hand, either internal or external, the light in the end of the tube flashes. Thus there is indicated the direction in which the job must be moved, and after the work is perfectly true the light burns continuously The indicator is claimed to be very sensitive and even the lightest touch of the needle causes the light to be flashed on A special holder is provided for the indicator, permitting of its use in the tool-post of a lathe or other machine, where it may be inconvenient to use a surface gage.



Electric test indicator mounted on usual surface gage

It will be noticed that this device is entirely self contained and no connecting wires are necessary



Electric test indicator mounted on a tool rest piece

Paper and Charcoal from Hopvines

GERMAN scientists are certainly leaving no stone unturned in their efforts to assist the Fatherland to utilize every possible product which can be turned into a national asset. One of the latest announcements made is that hopvines may be made to yield an excellent quality of fiber for use in jute mills and paper mills, and likewise charcoal for powder In the *Chemiker Zeitung* (Cöthen) August 7th, Otto Reinke states the result of his researches on the subject as follows

"Willow bark does not yield good fiber, the fiber being too closely surrounded The broom plant is not available, since if over treated with steam or soda lye the fibers are too short and too weak and like willow and hopvines it cannot easily be stripped except when treated with steam or a 0 5 per cent solution of hydrochloric or sulphuric acid while in spite of this the fiber remains too much incrusted to be satisfactory to our manufacturers of jute I therefore, began to experiment with the hopvine, which is available in large quantities, since our breweries use 500,000 heads of hops yearly in making beer, and the yield is about 8,000 plants per hectar

The fiber is difficult to isolate by means of lye, but can be easily stripped after softening in a 0 5 per cent solution of inorganic acid, as also by steam at about 0.5 at. But since old vines, when allowed to lie long in the open yield fiber free of the incrusting substance and easily stripped, obviously this method is preferable, or better still, artificial layering in warm damp piles or layers"

By this method Mr Reinke obtained a yield of 20 per cent of good fiber. The remaining wood, when treated with a 6 per cent solution of soda-lye at 3 at. gave exceptionally good paper fiber From the roots also very beautiful long fibered paper material was produced

The wood of the vine, which is hollow, was dried and subjected to dry distillation and carburisation. At 330 deg. Cent. beautiful red and brown charcoal was obtained, exhibiting the qualities demanded in good powder charcoal. Mr Reinke therefore urges all patriotic hop-growers to pile their cut vines and allow them to be rotted on end to ferment, and afterwards to dry for the sake of the fiber and charcoal obtainable.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

SHIRT.—H. GERHARDT, 418 Diamond Ave., Hazleton, Pa. This invention relates to shirts, and has reference more particularly to a shirt which will not pull out of the trousers of the wearer To obviate a number of objections, Mr Gerhardt designed a shirt which will not pull out of the trousers, which will leave the legs free and therefore not interfere with the movements of the wearer and which is convenient and simple in structure

Electrical Devices

CUT OUT AND SWITCH.—J J BUSSO, 129 Calhoun St. Charleston, S C The invention is especially adapted for use between high tension conductors and buildings, wherein mechanism is provided in connection with the switch for preventing over charging of the wiring of the building in case of break downs or improper action of the transformers the said mechanism being so arranged that an increase of voltage above a predetermined point will operate the said mechanism to disconnect the wiring of the building and to shunt the current to ground

Of Interest to Farmers

INSECT EXTERMINATOR.—W G ELKIN, French Camp, Miss. The invention provides an exterminator which may be readily driven by hand, its particular adaptation being for use in connection with cotton plants to trap and exterminate boll weevils, the device being in the nature of a hand operated ground wheel supported framework, carrying an adjustable container wherein some suitable liquid may be contained for killing the insects

CULTURE STARTER MAILING PACKET AND METHOD FOR MAKING THE SAME—B BARLOW, care of Albert Dickinson Co Box 788, Chicago, Ill This invention relates more particularly to a culture starter for making butter and cheese. The culture remains pure a long while in use, because the center of pure

CULTURE STARTING MAILING PACKET

growth is carried over when the sack is lifted from one bottom of pasteurized milk to another By other methods an average mixed sample is transferred. The culture is easy to handle and convenient in use. It has shown its advantage in transmission through the mail, as it goes in a sealed envelope as mail matter of first-class.

Of General Interest

BOOK MARKER.—HELEN S. CARSON, 4717 Kimbark Ave. Chicago, Ill This invention does away with the use of ribbons for holding the several marks in place within the book as arranged, and utilizes cover engaging strips, preferably of an adjustable nature adapting them for use in connection with books of different sizes, in place of such ribbons as illustrated in this inventors' former patent, No 1,066,822

PLASTER BOARD—J B WALSH, Herkimer Bldg., Jacksonville, Fla The improvement provides a plaster board formed of folding panels hingedly connected, for folding into compact form, for transportation, and arranged to be extended into the same plane to be applied flat, where no extra stiffness is required, thus eliminating joints between the panels, and eliminating the work of pointing joints, and preventing usual joint marks or cracks on the finish plaster

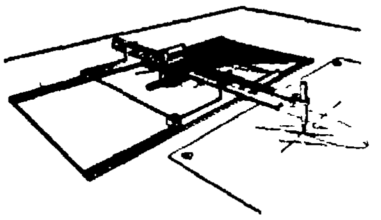
BOTTLE CAP AND OPENER.—N ELLIS, 407 Townsend St., Syracuse, N Y The invention relates to bottle caps and more particularly to means associated therewith whereby the cap can be removed from the bottle without the aid of the customary cap remover or opener, and consequently dispensing with the necessity of looking for one when bottles are to be opened.

PHOTOGRAPHIC CAMERA.—S ZACHARIA 491 Broadway Astoria, New York N Y This invention relates to cameras using roll films film packs plates or other sensitized mediums and an object is to provide a photographic camera arranged to permit convenient viewing of the image in correct position and in full size to facilitate accurate focusing

EGG CARRIER—I V BOWLEY, 25 Rollins St., Boston Mass This invention relates to packing and shipping devices and has particular reference to fillers for egg crates or the like wherein provision is made for holding individual articles such as eggs electric lamp bulbs, bottles or the like in spaced relation to one another

OPTHALMOSCOPE.—F A WELCH 412 W 115th St New York, N Y The ophthalmoscope has a lamp and peep hole closely adjacent the lamp and a rotary lens disk having a plurality of concentrically disposed series of lenses associated with the lamp and peep hole in such a manner as to shift the lens disk radially with relation to the lamp so as to bring any lens of either series within the line of sight.

ELLIPSOGRAPH—F KIRK and L I FRANCISCO, P O Box 10 Canon City Colo This invention provides a device designed for use by draftsmen and others for drawing perfect ellipses wherein a table is provided and a carriage having guided movement on the table



ELLIPSOGRAPH

together with an arm moving transversely of the table and provided with marking means and connected to the table in such manner that the combined movement of the arm and the table will permit the drawing of a perfect ellipse

DEVICE FOR AUTOMATICALLY ANCHORING SUBMARINE MINES AT A PREDETERMINED DEPTH INDEPENDENTLY OF THE BOTTOM OF THE SEA G E ELIA Hotel de Crillon Place de la Concorde Paris France The anchoring device forming the object of this invention permits of realizing the automatic transformation of anchored mines into floating mines when the depth of the sea exceeds the length of the mooring cable contained in the anchor so that soon after the launching the submarine mine places itself automatically at a predetermined depth whatever the depth of the sea may be

APPARATUS FOR PROMOTING THE GROWTH OF HAIR—L. J WIDNESS, 208 Van Buren St Brooklyn New York N Y The invention relates particularly with respect to the hair and the main object thereof is to provide mechanical means for raising the scalp from the skull to permit the previously impeded circulation of blood due to a tight scalp to resume its normal flow and thus feed the hair follicles and hair roots and inducing the growth of the hair

POST CARD RACK—G HONIG, Alice Tex This device comprises a rotary holder or rack mounted for rotation around a vertical axis and including a skirt like outer wall of flexible material folded so as to form circumferentially arranged pockets into which the lower ends of a large quantity of post cards or the like may be inserted and supported in connection with certain other elements of the structure

BOTTLE VALVE—C F LENG 42 Broadway New York N Y This invention provides a valve more especially designed to prevent refilling of the bottle by force or by the use of a vacuum to allow easy and smooth decanting of the contents, and to prevent the valve from being forced down into the bottle or being removed therefrom after it is once inserted in the neck of the bottle.

NEWSPAPER EASEL—J McCARTHY Address McCarthy Edge & Cleland 909 911 Paulsen Bldg, Spokane, Wash This invention has for one of its principal objects, the production of a device of convenient size and shape adapted to hold a newspaper or other reading matter while the reader is dining or is otherwise so situated that his hands are not free to hold the paper

DINNER PAIL—W R WRIGHT 518 W 4th St. Marion Ind Among the objects of this invention is the provision of a dinner pail that shall, within the usual compass not only provide suitable containers for both solid and liquid food, but also within that compass provide means for heating the said food

Hardware and Tools

DRAWING PEN REGULATOR—M P STROCK, 1041 Grandview Boulder Colo This improvement relates to drawing pens and has reference more particularly to means for regulating the width of the line to be drawn and whereby any predetermined width of line can be easily obtained by setting the regulator of the pen at a predetermined position

SWIVEL JOINT FOR HOSE REELS.—S CLAY, address Harry E. Hoke Hanover, Pa. This invention refers to swivel joint hose connections and more particularly to a swivel joint, especially adapted for use in connection with hose reels to form one of the notable supports thereof the object being to enable a hose and reel to carry hose of varying lengths thus permitting the sprinkling operation to be accomplished with the use of a given length of hose without unwinding all of the same from the reel

LOCK—G A WEHNER 420 Habersham St Savannah Ga The invention provides a lock of the permutation type wherein a bolt is provided, and a casing having means for locking the bolt in locking position the bolt and lock members being normally spring released and wherein a series of push buttons is provided in connection with the casing normally spring held in outward position and capable of being depressed sundry of the buttons being positive and others negative in their action so that when the positive buttons are simultaneously depressed the locking mechanism for the bolt will be released and when the negative button is depressed it will impede and prevent any release of the locking mechanism for the bolt

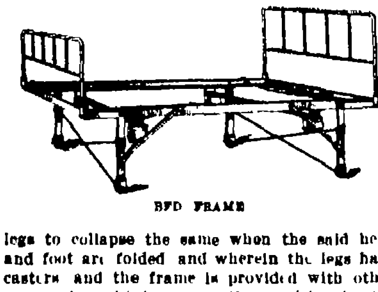
WRENCH—I N PECK care of C J O Brien 227 William St New York N Y The wrench is arranged to provide a plurality of differently sized and shaped wrench heads and handles for taking hold of the wrench one handle for each head and so positioned relative thereto that the user can effectively turn the part engaged by the corresponding wrench head.

DETACHABLE COMBINATION LOCK—G T OLDHAM Address George S Elliott Fifth Avenue Bank New York N Y This improvement has for its object to provide a detachable combination lock having a shank with a lateral shaft for disposal in an opening in a key plate a combination locking device being mounted on the shank for cooperating with teeth on the edge of the shaft

Household Utilities

WARDROBE FIXTURE—B BRAGER 49 Crosby St New York N Y The improvement refers to wardrobe fixtures for supporting coat or other garment hangers and has particular reference to devices adapted to be connected to or suspended beneath the horizontal shelves of wardrobes clothes closets or the like for supporting any suitable number size or type of individual garment hangers

BED FRAME—N SINCLAIR 1405 Bannock St Boise Idaho This invention provides a frame wherein collapsible supporting legs are provided together with a folding head and a folding foot capable of being folded over upon the body of the frame and connected with the



BED FRAME

legs to collapse the same when the said head and foot are folded and wherein the legs have casters and the frame is provided with other casters brought into operative position by the folding of the frame and arranged to permit the frame to be moved laterally thus adapting the frame for insertion beneath another bed

Machines and Mechanical Devices

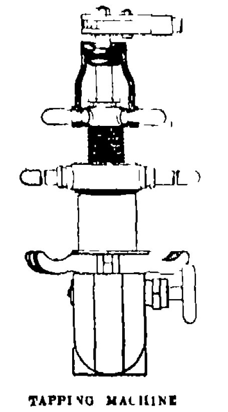
MOTION COUNTER—W R. AYARS and B M ANDERSON Rome, N Y The inventor provides a motion counter for convenient application to a moving part of a machine the motions of which are to be counted and arranged to indicate the number of motions made by the moving member of a machine and at the same time registering the time during which the motions are counted

SAFETY COUPLING—G O FLOGLAND, 2929 Clinton Ave Minneapolis Minn This coupling is of the class adapted for connecting the propeller wheel to its shaft wherein mechanism is provided for preventing injury to the propeller or the shaft when the propeller strikes an obstruction the said mechanism being arranged to permit relative movement of the propeller and the shaft when the propeller strikes an obstruction, and wherein the parts will automatically return to their normal position as soon as the wheel is released.

ATTACHMENT FOR PNEUMATIC MACHINE RIVETERS—W STARK 1606 Lester Ave Kansas City, Mo This improvement provides an attachment for application to the front end of the riveter set and to be manually held thereto to constitute a forward extension of the riveter whereby to perform general work now performed by separate and less efficient machines, such as the work of a backing out punch a cold cutter a gouge or a diamond point generally used in cutting boiler plates or like sheet metal

ATTACHMENT FOR PROPELLING ELEVATING AND SUPPORTING SHIPS BOATS SUBMARINES AND THE LIKE VESSELS—P U LOUBERY No 5 Quai de l'Industrie, Juvisy, Seine-et-Oise, France This invention provides apparatus for propelling elevating and supporting ships boats, submarines etc and it consists substantially in an arrangement and construction of rotary propellers of the feathering vane type on driving shafts extending through the skin of the hull approximately at right angles to the length of the vessel

TAPPING MACHINE—H W ALCORN and I R CRAVATT 524 16th Ave Barberton Ohio The invention relates to pipe tapping machines as in water gas oil or other systems and the main object thereof is to provide an attachment for conventional tapping machines which



TAPPING MACHINE

renders the tapping operation much easier and quicker than is now possible The attachment obviates the wear of a portion of the conventional machines thereby avoiding the necessity for frequent and costly replacement of the worn portion

Musical Instruments

PLAYER PIANO H A CLAUSING 406 Nye St Lima Ohio This improvement provides a player piano arranged to permit variable accentuation of solo themes or other parts of the music in either treble or base to provide an octave coupler for increase in the volume of the tone especially when the instrument is used in large rooms or halls and to permit the performers to throw off the dampers for sostenuto playing

Prime Movers and Their Accessories

VALVE LIFTER—R I HENDERSON 149 E 54th St New York N Y The valve lifter is for use in connection with the valves of internal combustion engines Devices for the purpose involve as essentials means to bear against the valve to clamp the same and means to engage the washer of the valve stem beneath the spring in a manner to exert pressure on the spring and compress the same for the ready removal of the cotter pin or equivalent expedient employed for retaining the washer

INTERNAL COMBUSTION ENGINE—J KEISTER Steubenville O Mr Keister's invention has reference to internal combustion engines especially of the type designed for use on motor vehicles and it includes improved valve mechanism and operating connections therefor by means of which ordinary valves of the puppet type are dispensed with

Railways and Their Accessories

RAIL JOINT—J C FELKERS Y M C A Building Beaumont Tex One of the principal objects here is to provide an improved joint employing means without the use of bolts for securely connecting adjacent rail ends together and holding them in place against longitudinal and spreading movement.

Pertaining to Vehicles

REAR END SIGNAL FOR VEHICLES—C F MARSTON 825 Johnson St Flatbush Brooklyn New York N Y This inventor provides a signal having means readily operable by the foot of the driver to selectively actuate signs to indicate his intent provides a foot pedal for controlling the driving mechanism of a vehicle having mounted thereon a series of electrical contacts for completing operating electric circuits to dispose in view and selectively signs or implements the proposed movement of the vehicle having the signal

AIR COMPRESSOR MOTOR—D F CROUSE, T DAVIS and CHARLES C KIDSON Address the last care of The Auto Air Appliance Co Industrial Bldg Baltimore Md The improvement provides a device which may be run by any suitable power means as for instance the shaft of an automobile engine and which will compress air into a tank or other suitable reservoir and which may subsequently be used as a motor when the compressed air in the tank is admitted into the cylinders of the device

RESILIENT WHEEL—R F BRUNNOW, Edgehill N J The purpose here is to provide a wheel for use on automobiles auto trucks or other vehicles and arranged to dispense entirely with pneumatic tubes and similar devices now generally employed to obtain resiliency and to provide a tire which can be cheaply manufactured and not liable to get out of order

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NOTE—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each Please state the name of the patentee, title of the invention and date of this paper

A Horses' Hospital

(Concluded from page 126)

There are also available three race-courses one of which is resorted to when even the reception stable does not suffice to cope with actual requirements, while the two others are used to give healthy horses an airing, and finally, there is a farrier's shop the chief veterinary's office a chemist's shop and a laboratory The men and non-commissioned officers are housed in barracks of their own, where there is also the commander's office

The staff at present comprises the chief veterinary surgeon three veterinaries and two assistant veterinaries each of whom is assisted by two men trained for the veterinary sanitation service, and a farrier Each veterinary has under his charge at least 100 patients

The general treatment and surgical operations are superintended by the chief veterinary Horses affected with glanders are killed and dissected immediately those suspected of this terrible malady are isolated and subjected to a renewed Malleine test Horses suffering from incurable external disease if free from fever are handed over to the horse slaughterer those with fever are killed and handed over to the flayer A board installed near each horse's manger indicates its date of reception and sort of complaint Much care is bestowed on keeping the horses' skin, hoofs and legs in proper condition as well as on cleanliness ventilation and disinfection of the stables Each horse has a watering bucket of its own.

Service at the veterinary hospital lasts from 8 to 11 30 A M and from 2 to 5 30 P M The chief surgeon each day visits the patients of some stable with a view of ascertaining any infectious diseases, examining the condition of hoofs etc, so that all the horses in the hospital are examined once a week Those horses which are received at the delivery stable are treated with special care, fed on a special plan given an airing every day and brought into such condition as to be immediately fit for heavy service with their detachment. Patients likely to remain at the hospital for some length of time are deprived of their horseshoes and, if required, are given a daily airing Pregnant mares, mares with foals, and jaded horses are allowed a long rest every day on the grounds close to the hospital Flaked oats are used extensively in feeding emaciated horses

In order to protect patients against glanders, and to localize any outbreak of this disease, each horse, as above mentioned, is on reception, submitted to the Malleine test Moreover, a blood sample of each new arrival is sent to the laboratory, and all the horses are subjected to the Malleine test every three weeks, and to a blood test, once a month

It has thus been possible to keep glanders out of the hospital, though 103 patients suffering from the disease had to be killed

The following figures will give an idea of the useful work done at the hospital A total of 1,995 horses were received at the hospital from its date of opening (November 23rd 1914) until the end of May, the last date for which statistical data were available Out of this total, 973 were discharged as cured to their respective detachments, 103 affected with glanders were killed, 128 were sold to the horse slaughterer as suffering from incurable external disease 92 died or were killed because suffering from feverish external disease, 49 were handed over to other depots or detachments, 12 mares in foal were handed over to the Chamber of Agriculture and 84 were sold to farmers, because unfit for military service or being unworthy the fodder The total left at the hospital thus was 554 horses. Extensive operations had to be made on a number of patients.

Whenever unable to be operated on standing, patients are suspended from an attachment such as is used in equine obstetrics, no special operating table being as yet available. Most operations are performed in a chloral hydrate narcosis or local anesthesia (produced by injection of a cocaine-adrenaline solution)

Those horses which after operation are found to be unsuitable for war duty are sold at an acceptable price to farmers of Eastern Prussia who have returned to their devastated farms, thus in a measure remedying the prevailing scarceness

One hundred and forty eight men of the German Landsturm, mostly with a long practice in the handling of horses have been appointed to tend and care for the inmates of the hospital Non commissioned officers act as superintendents

By employing all the available resources, a veterinary hospital such as this is able to cure a considerable number of invalid horses and by surgical operations to make a great many wounded ones fit again for war use which otherwise would unavoidably be doomed to death at the slaughterer's hand or by a welcome bullet Those cured are by a proper treatment *made suitable again for heavy service* thus filling any gaps and restoring to each detachment their own horses a practice bound to make for increased fighting fitness Considerable values are in this way saved for the state and veterinary surgeons are enabled to increase their stock of professional experience

German Commercial Preparedness for Peace

(Concluded from page 124)

This latter statement is somewhat cryptic It reveals the Teutonic preparations for peace as practised by one of its most powerful and profitable industrial concerns Notwithstanding the war the branches in Switzerland, Scandinavia Spain and Holland have been able to carry on business satisfactorily and incidentally it may be mentioned that the British branch in London is in a healthy and flourishing condition

One item is not without its significance Following the outbreak of war the trust was compelled to lay down extensions of buildings and to equip them with new and expensive machinery During the year the latter has earned sufficient to enable the cost to be entirely written off and they are nominally valued at one shilling per works!

If one company is able to achieve such an end during a single year of war, is it not logical to assume that a large proportion of the other industries of Germany are similarly placed? At all events, German industrial organizations are carrying on in such a manner that there is no danger of commercial posterity being bowed down with the weighty millstones incurred by the war

America Prepares

So far only one country has realized the fact that Germany is bent upon waging a bitter and prolonged commercial war when once the sword is sheathed The commercial princes of the United States, from the fact that their country is neutral and they are at liberty to wander hither and thither through Germany, have seen with their own eyes the vast organization which Germany is piling *up to wage her industrial campaign*

They have convinced their government, and the authorities have taken all preliminaries to counter the step the moment it asserts itself It is not so much a question of protection as the elaboration of precautionary measures to prevent unprincipled and unscrupulous dumping

Australia has not been slow to emulate the American example although in this instance there is a tendency more towards whole hogging The land under the Southern Cross has pledged itself to have nothing more to do with German made goods. Unfortunately there is a saving clause The boycott will only apply provided that the articles can be obtained from within the Empire and at a fair figure

The indefatigable efforts which are being made in German commercial circles against the day when she may resume her world wide trading may serve to reveal which way the wind is blowing This activity would not be so acute were peace very remote. Commerce is a fickle goddess. Whims and fancies vary so much that large stocks cannot be laid up indefinitely they may be superseded or become considered obsolete.

Germany's Advantage

Germany is in a superior position as compared with this country She has only to satisfy her own military machine Austria is quite capable of fulfilling all the needs of her own war department True, Bulgaria and Turkey are making certain calls upon the armament producing facilities of the two Empires, but they are negligible in comparison with what the Allies require France, being deprived of her northern industrial centers, has had to depend to a great extent upon this country while Russia has also been an insatiable customer for munitions.

But, as already mentioned the critical moment in this special field of production has been reached and passed In this country we now know exactly where we stand and what we can do Owing to the complete mobilization of our resources we are in a position to meet any demand that may arise and the strain has been alleviated somewhat by Japan and the United States

The period of eased production has already commenced, and while it is not appreciable it affords us the opportunity to reflect Without slackening in our efforts it should be possible to adjust the commercial machinery in such a manner and to set the industrial wheels in such a direction as to enable the commercial vehicle to be restarted and to enable speed in this direction to be gathered as the output of munitions slows down

One should balance the other so as to keep our manufacturing resources at tip-top pressure whether it be for the needs of the moment or of those six months hence

Coming Transport War

So far as Britain is concerned no definite line of action to meet the threatened commercial invasion has been laid down But evidently the skeleton of a precautionary scheme has been adumbrated, judging from the slender statements which have been dropped in the House of Commons. A 'Zollverein' of the Allies has been suggested and will probably come into operation in some form or other The Trade Federation of the Empire is more probable

The fact remains that some cleverly contrived effective and adequate plan of commercial campaign will need to be drawn up, otherwise Germany will not only be in a position to make up for all she has lost by war, but will enable her to forge the weapons wherewith to ensure the commercial, if not the military and political, domination of the world

Of one thing we may be certain Germany's mercantile marine is hopelessly tied up through the vigilance and power of the British fleet. But when the mooring ropes can be cast off there will be a spirited and vigorous rate war Conferences and rings will be impossible inasmuch as racial feelings will be too strained to enable community of interests to be arranged so far as the water traffic is concerned

The vast stocks accumulated will have to be cleared out of the factories at all hazards and we may confidently anticipate that they will be despatched to the markets of the world at very cut rates when overseas commerce once more becomes possible

Germany's Huge Purchases

Not only are the ships and their cargoes ready in Germany, but this wonderful foresight is going so far as to buy cargoes of much needed products in countries where German ships are interned According to the New York correspondent of the *Times*

"Purchases aggregating in value £20,000 000 are reported to have been secretly completed by Germany in that country They consist of copper, cotton, wool, lard, wheat, agricultural machinery, and other products.

"All these products have been bought subject to delivery in Germany 'sixty days after the war ends' or 'on order,' with the exception of wheat, all the purchases being stored in close proximity to

Atlantic ports, where many German merchantmen are interned. According to one report an order for small tractor engines built for farm work was actually delivered on shipboard at Newport News.

"Most of the products were bought on a margin which would involve large bank loans."

According to the *Chicago Herald* the operations of the German secret purchasing agents are as follows

"Copper Approximately 50,000,000 pounds, largely of electrolytic copper, bought on a 4 per cent margin, with an agreement to keep this margin under the market. The price paid ranges between 18½ and 19 cents.

"Cotton 500 000 bales are said to have been bought. The buying operations have extended over several months.

"Wool. The estimates vary as to the amount stored, but it is agreed that the operations are not as large as in the cotton market.

"Lard Purchases are now being made openly

"Wheat. It is believed that millions of bushels have been bought, in addition to large quantities of maize.

"Farm machinery In addition to tractor engines, every kind of machinery for use on farms and in factories, which have been stored on the eastern seaboard

"German American bankers describe these purchases as designed to establish 'preparedness for peace'"

Wanted—A Financing Syndicate

The fact must not be overlooked that these craft will be ready to steam out of German and neutral harbors when the moment arrives On the other hand, several months must elapse before the British mercantile marine will settle down to its stride

The tramps will be immediately available for duty, but the liners will have to go into dock for overhaul and extensive repair if not actual reconstruction before they will be able to resume their sailings upon the seven seas This work will occupy considerable time—sufficient to enable the Germans to reassert their strength.

The recent move which has been consummated in United States financial circles should stimulate us to prompt action There a special syndicate has been formed with a capital of £10 000,000 to develop and to finance commercial expansion in neutral markets It is to all intents and purposes an American reply to the German game, which in the past has proved so highly profitable

To us such a syndicate is a friendly menace Briton and American will be brought face to face upon common ground with the German striving to undercut both Germany is convinced that within a few weeks of the declaration of peace she will have retrieved her Russian trade which attained huge proportions The American syndicate proposes to devote special attention to this territory, relying upon Russian antagonism to Teutonic methods and trade to scoop the business

Unless we are prepared to adopt similar methods there is but little doubt that America will succeed in her peaceful conquest. It should not be a difficult matter to establish a similar syndicate in London, and to provide it with similar weapons of war

With such a backing we should be better able to enter foreign markets formerly held by Germany

To capture this trade it will be incumbent upon us to offer to do business upon terms comparable with those of Germany of old. It was only by giving more advantageous terms and by meeting local requirements in a manner superior to that of conservative Britain that Germany was able to make such huge commercial strides overseas.

It is sheer waste of time to criticise and ridicule the Teuton methods, because they proved successful No injury can result from taking a leaf out of the enemy's book, especially when it enables you to fight him squarely upon his own ground. Enterprise, initiative, and immediate action are absolutely imperative if we intend to oust the Teuton from his markets. To wait and see how things develop after the war will spell commercial suicide the German will get there again as he did before.

[From the British *World's Work*.]

Speedy Patrol Boats for the U. S. Navy

(*Concluded from page 122*)

description would pound badly in rough water, but it is claimed that this is over come by the air cushion above mentioned, and the great proportional beam makes a steady boat, as far as rolling is concerned

Besides being unique in design the method of propelling these boats is unusual as what is known as surface propulsion is employed. In this system the shaft of the wheel is set at about the water line at the stern, and the propeller wheel revolves half in the water and half out. Special advantages are claimed for the system, and it has been successful with the sea sleds Some of these advantages are the slight draught of water required the absence of any strut or exposed shaft and the rigid support that can be given the wheels, by well lubricated stuffing boxes located in the stern framing of the boat.

In the particular boat shown in the illustrations which is the largest that has been built four propellers are fitted each driven by its own individual gasoline engine and these screws work in pairs one pair turning to the right and the other pair to the left. This is distinctly shown in one of the illustrations

The other two pictures show the boat running In one of these the boat is just starting and it will be noticed that the wheels are throwing up a great cloud of spray, high above the stern, but as the craft gathers speed the disturbance of the water at the stern is much less, and the boat begins to 'plane in the same manner as the ordinary hydroplane. This is shown in the second picture, and it will be noticed that when running at high speed practically no spray is thrown up forward, and the boat slides over the water very smoothly

Owing to the light draught of the boat, and the arrangement of the wheels, the steering presented a problem This was solved by hanging a rudder on each side of the boat at its stern, each one projecting slightly below and behind the hull Only one of these rudders operates at a time, and they are hung on a hinge at their forward end which is set at an angle so that they cut under when swung out, and this tends to pull the inward side of the craft down on the turn, thus counteracting the heeling effect

Unusually high speeds are attained by these peculiar boats and it is anticipated that they will prove useful in the Navy for a number of purposes

Patent Office Transactions for Fiscal Year Ending June 30, 1915

DURING the past fifty years the people of the United States have uttered two thirds of all the revolutionary epoch making inventions of the world ranging from the telephone and the incandescent lamp to Wright's aeroplane and high speed steel Each day the United States Patent Office issues an average of 200 letters patent to American inventors and the number of inventions is increasing with the years

During the fiscal year ended June 30th 1915, there were filed 66 497 applications for patents for inventions, 2 679 applications for design patents 173 applications for reissues, 8 376 applications for registration of trade-marks 947 applications for labels, and 444 applications for prints, the total number of such applications being 79,116. In addition, 1,938 appeals and 26 disclaimers were filed

During the year there were granted 44,402 patents (including 1,489 designs and 179 reissues) 6,910 registrations for trade-marks, 762 registrations for labels, and 321 registrations for prints. The number of patents which expired during the year was 20,902. The number of allowed applications which were forfeited

for non-payment of final fees therein was 11,882.

The total receipts of the Patent Office were $2,270,937 68, and the total expenditures for all purposes were $2,087,581.26, the net surplus of earnings over expenditures being $183,356 42 for the year, with a grand net surplus of $7,714,316 62 since the establishment of the present system in 1836

There are four points of special interest in the work of the Patent Office during the past year FIRST For the first time in years the office disposed of as many applications as were received, although the number of applications filed has not fallen off During the years 1912 and 1913 there were filed 8,000 more applications per year than were disposed of

SECOND The total number of applications awaiting action June 30th, 1914, was 22 283 On June 30th, 1915, there were 18 270, a decrease of 4 013

THIRD The number of patents granted in 1914 was 38,225 and the number in 1915, 44,402, an increase of 6 177

FOURTH There was caused a reduction in the number of interferences declared from 1,129 in 1914 to 916 in 1915—a decrease of 213

NEW BOOKS, ETC

CIVILIZATION AND CLIMATE By Ellsworth Huntington New Haven Yale University Press 1915 8vo, 333 pp, illustrated Price $2 50 net

Not so very long ago geography used to confine itself to the physical features of the earth's surface the newer geography interests itself in the distribution of plants animals, and man A step further in the relationship between geographic environment and vital phenomena is taken in the author's Civilization and Climate which seeks to map human character as expressed in civilization He leans to the belief that the great countries of antiquity, no matter what their present climate may be enjoyed during their rise to power a climatic stimulus comparable with that existing to-day where the leading nations now dwell From the study of thousands of factory hands and students at all seasons, the author arrives at an approximate measurement of the climatic elements that influence efficiency His pulsatory hypothesis holds that while the past was moister than the present, the changes have taken place irregularly in great waves Whether the reader be interested primarily in humidity or in humanity the thoughtful vigor of this thesis will hold his respectful attention even though he may be unable to agree with all its conclusions

A HANDBOOK OF COLLOID-CHEMISTRY The Recognition of Colloids the Theory of Colloids and Their General Physico-Chemical Properties By Dr Wolfgang Ostwald, Privatdozent in the University of Leipzig Translated from the Third German Edition by Dr Martin H Fischer Philadelphia P Blakiston's Son & Co 1915 8vo., 278 pp, illustrated Price, $3 net

The translator's preface to Dr Ostwald's authoritative text points out that, useful as crystalloid investigation has been, it is the colloid form in which Nature best reveals herself This aspect is of the widest appeal not only to the abstract thinker but also to the agriculturist, the metallurgist the tanner the manufacturers of paper and of paint the dyer, the weaver and numerous other followers of the practical occupations The introduction treats of elementary, general and special analyses. Part I discusses general, and Part II special colloid-chemistry The work sets forth the mechanical properties of colloid systems in considerable detail We should be grateful to the translator and to the publishers for giving this classic to the English speaking public, for seven years had passed and, the work was in its third German edition, before the opportunity was afforded us of reading this text in our own language

INVENTIONS AND PATENTS By Philip E. Edelman New York D Van Nostrand Company 1915 8vo, 288 pp, illustrated. Price, $1 50 net.

That there is a most deplorable ignorance of the points involved in patent procedure cannot be denied. The waste in time and money directly due to this ignorance is incalculable and such chapters of the work in hand as "Patent Attorneys" "Patentability and Practicability," and "Protecting an Invention" will prove of the highest usefulness to inventors. These and other chapters should find an interested following among investors and manufacturers. While we may not agree with the author in his contention that inventors form a class perhaps higher than any other to which human beings belong, we must admit that to the inventor is due the essential scheme of our modern civilization, and he is deserving of all the help that can be extended to him. The work should be read by all who are in any way interested in inventions and their protection An appendix carries many useful forms of assignment, employes agreements and options. As a whole the volume is to be heartily commended.

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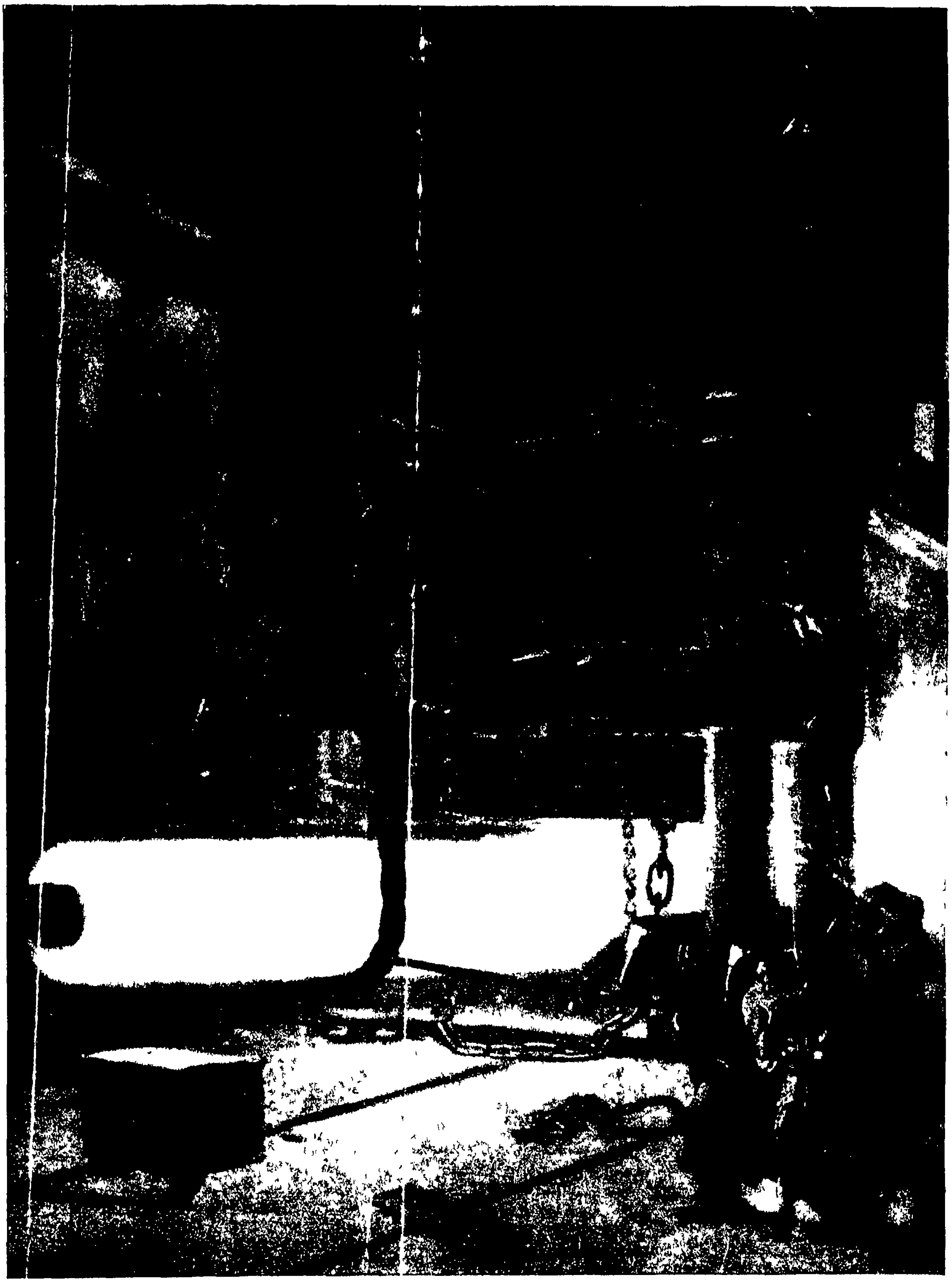

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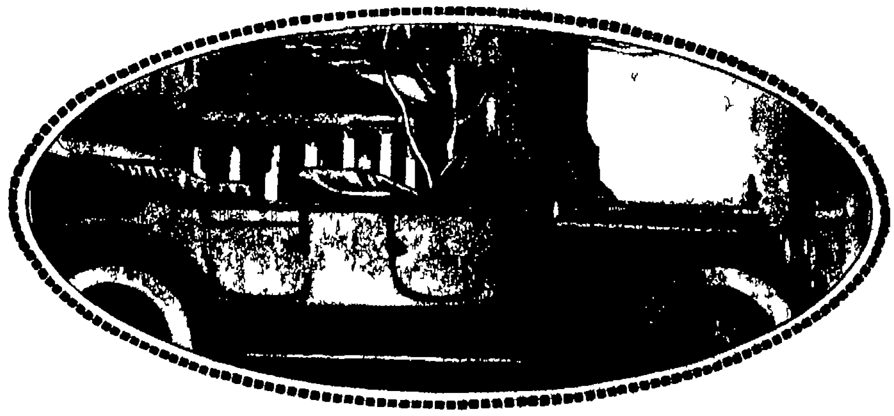

SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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Members of the Naval Militia on target range for annual qualification practice

Naval Militia and Preparedness

Discussing the Work and Aims of This Organization

By Lieut W. J Willis, N M N Y

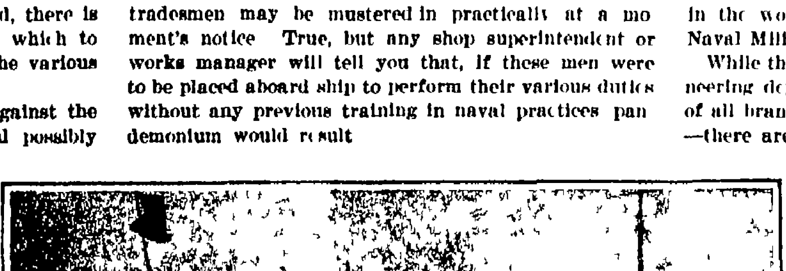
DURING the present nation wide agitation about preparedness and means toward that end, there is an existing and very important basis upon which to build, in the form of the Naval Militia of the various states.

The consensus of opinion is apparently against the maintenance of a large standing army and possibly against the maintenance of the Navy at full war strength. Each of the courses suggested for adequate preparedness lays stress upon the necessity for the inauguration of an adequate first-line-of relief for the standing Army and Navy. The National Guard is intended to serve this very purpose to the Army, and the Naval Militia bears the same relation to the Navy.

While the Naval Militia constitutes a part of the National Guard organization of the separate states, its instruction and training are under the direction of the Bureau of Naval Militia Affairs of the Navy Department. This training is designed to prepare the separate units of the Naval Militia for absorption into the regular navy, when necessary, with the least confusion possible. In other words, the Naval Militia must be trained in the discipline, practices and usages which experience has demonstrated as tending toward highest efficiency.

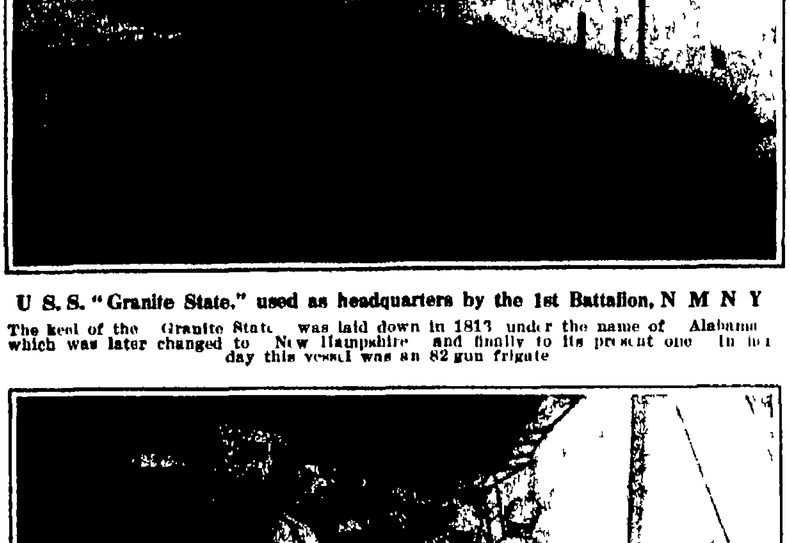
The operation of a modern man-of war requires all of the diversified trades and professions represented in the operation of any large manufacturing plant, aside from trained gun pointers and sight setters. If the gun-pointer is to be allowed to use his skill against an enemy, he must be placed within range and kept within range. This necessitates an efficient engine-room and deck force. An engine-room force consists not merely of throttle-men and firemen, but also of machinists, electricians, water-tenders, oilers, blacksmiths, pipefitters, tinsmiths, and others down through all of the trades. The efficient direction of these various pursuits requires the presence of trained electrical and mechanical engineers. The care and preservation of the health of the men require the presence of doctors, pharmacists, and male nurses. That the men may be properly fed, cooks, mess-attendants, and an efficient commissary department are necessary. In like manner, the keeping of records and the issuance of orders require a force of stenographers and clerks.

The layman will immediately think that these various tradesmen may be mustered in practically at a moment's notice. True, but any shop superintendent or works manager will tell you that, if these men were to be placed aboard ship to perform their various duties without any previous training in naval practices pandemonium would result.



U. S. S. "Granite State," used as headquarters by the 1st Battalion, N M N Y

The keel of the Granite State was laid down in 1813 under the name of Alabama which was later changed to New Hampshire and finally to its present one. In her day this vessel was an 82 gun frigate



Naval Militia gun crew at 3-pounder qualification target practice

If a ship is to be operated efficiently, all friction between the various departments must be prevented, and this end is attained by having one supreme head to each ship. Unquestioning obedience to the orders emanating from this head, therefore, becomes absolutely essential. The American citizen is probably less amenable to this sort of obedience than any other race in the world. It accordingly falls to the lot of the Naval Militia to teach discipline first.

While the Naval Militia, and more especially the engineering department, offers an opportunity to artificers of all branches to increase their value to their country—there are always sufficient untrained hands and minds to fill the ranks of the more pronounced military branches—by the practice of their different trades and professions it is the aim of this branch of the National Guard to increase this value by courses of instruction and by lectures along the lines of each specific trade. Needless to state this instruction is bound to increase the economic value of the men in civil life.

Inasmuch as service in the National Guard or Naval Militia is strictly voluntary an enlistment must presuppose the presence of some patriotism. There are physical disabilities which disqualify the enlistment of many men, but even those physically disqualified may demonstrate their patriotism by doing all in their power to foster the same spirit in others. Patriotism does not mean the willingness to die for one's country only, but also the willingness and the desire to be of the greatest value to one's country in any branch or department. A good teamster is of more value to the commissary department far in the rear than he would be as a poor shot in the first line trenches. A good cook is more valuable in feeding the crew well than he would be as a slow shellman serving one of the large guns.

In the case of the enlistment of an ordinary young American into the Navy, he must be trained not only into a Navy man but also into an artificer of some branch before his full value is realized. The Naval Militia offers an opportunity to the mature American trained in any craft to make himself a fully qualified Navy man subject who can be called in case of need by giving him instruction in the relation between his particular trade and the efficient operation of a man-of-war.

Although the Naval Militia in order to fulfill its functions must be a military organization primarily, it is made as attractive as possible in ways other than those of offering instruction in various trades and pursuits. Each unit combines a social organization with the military. This social organization is in

(Concluded on page 164)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Preparedness and the Naval Militia

IN another portion of this issue appears an article which shows the relation of the Naval Militia to national preparedness.

American citizenship carries with it responsibilities as well as privileges. The privileges are many and varied. The responsibilities are fewer, but just as well defined. The franchise is both a privilege and a responsibility. We are sorry to say that we are of the opinion that the average citizen exercises the right of franchise as a privilege only. When an American citizen takes the oath of allegiance or casts his first vote he must assume the responsibilities of citizenship as well as the privileges. A person, unless he is unworthy of recognition as a citizen, must be actuated by patriotism when he takes the oath of allegiance or casts his first vote. The final attitude to be assumed by Congress toward preparedness is one of the responsibilities to be assumed by the American voter.

Each man is apparently content to let the other fellow assume all responsibilities. Just at present the country at large is sitting back and waiting to see what Congress is going to do about it. What *can* Congress do except vote an appropriation? This is the first step only. The next step is up to the private citizen individually. A big navy, authorized by Congress, is of no value if inadequately manned. A large standing army would be a useless sacrifice without a "first line-of relief." If a large navy is authorized by Congress there must be means at hand for rounding out the crews to full war strength at a moment's notice and for filling the vacancies caused by casualties. These vacancies may not be filled with green inexperienced men without sacrificing the efficiency of the entire body. Consequently a Naval Reserve is imperative. Is the American citizen going to refuse to assume this responsibility attendant upon his citizenship and thus make compulsory service imperative? We certainly hope not.

Patriotism! That word is defined as "love of country." Truly it represents the life of a nation. When patriotism dies national honor and integrity go with it. A nation can no more stand without honor and integrity than can an individual or a corporation.

The patriotism of the individual is best demonstrated by his willingness and desire to serve his country in the capacity for which he is best fitted whether it is as mess-cook or teamster, admiral or general. The physically disqualified may be able to merely encourage others, but it is patriotism nevertheless. The employer should encourage patriotism among his employees not because it represents insurance against war losses but because it is his duty as a citizen. The Congressman may demonstrate his patriotism by dealing with the current questions of national honor and integrity and of national preparedness with his own political well being sunk well into the background.

At the present date the Naval Militia of the United States consists of 523 officers and 5,840 men. If all of the various units were perfectly balanced and efficiently trained this would be sufficient to man about eight of the larger ships in case of stress. As a reserve, it therefore amounts to the proverbial "drop in the bucket," but as a nucleus about which to build it represents the most wonderful opportunity for the trained American to demonstrate his patriotism to the fullest. The opportunity is there for the trained engineer, the professional man as well. The rank and file must be officered, while still the militia for drill and instruction purposes, and upon going aboard ship there must be officers to assume the responsibility for the operation of the engine room and auxiliary machinery.

The employer, whether large or small, can express his approval of the National Guard organisation in a variety of ways. One of the largest department stores in the country not only grants leave-of-absence with pay to all employees absent on military duty, but has founded and equipped an entire machine-gun company. A New England company grants not leave-of-absence with pay, but leave-of-absence with double pay to its employees away on duty. Most of the large corporations in the East now grant leave-of-absence with pay to all employees away on ordered military duty with no loss of vacation time.

If each American citizen does his duty according to his station in life, national preparedness will become a question of the past and a well-established, world-wide known fact of the present and future.

Shall We Abolish the Fahrenheit Thermometer?

REPRESENTATIVE ALBERT JOHNSON, of Washington, has sent to all members of the American Association for the Advancement of Science copies of a speech which he delivered in the House of Representatives last December in behalf of his bill, introduced at the present session of Congress, to discontinue the use of the Fahrenheit thermometer scale in Government publications. Together with this document he sends a circular, in which he solicits the advice and coöperation of the members of the association in connection with his project. The circular indicates that he entertains no doubt as to the desirability of abolishing the Fahrenheit scale, but is open minded as to the way in which this reform should be effected, in order to produce a minimum of inconvenience. The bill, as introduced, provides for a transition period, terminating January 1st, 1920, during which the branches of the Government may gradually adjust themselves to the use of the centigrade scale, and permits, during the same period, the use of Fahrenheit equivalents of centigrade degrees in parentheses, or otherwise as may seem desirable.

Annexed to Mr. Johnson's bill are extracts from a number of opinions of the project which he obtained, before introducing the bill, from scientific societies and individuals. Most of these are favorable. He has now adopted the commendable plan of enlisting the aid of the American Association in a more thorough canvass of public opinion, and a committee of the association has taken this matter in hand.

It is superfluous to point out that a proposal to eliminate the Fahrenheit scale from all Government publications is one which ought to be most carefully considered before an irrevocable decision is taken. As matters now stand, the Government uses both scales, the centigrade, in connection with metric measurements in most of its scientific work, the Fahrenheit, in connection with English measurements, in its industrial and business relations. The proposed change would, perhaps, not affect, to a very serious extent, any scientific branch of the Government except the Weather Bureau, which now makes comparatively little use of the centigrade scale because the results of its activities are addressed, for the most part, to a public familiar only with Fahrenheit. It would be no easy task to educate that public to think of "zero weather" as meaning just freezing, or of "ninety in the shade" as a temperature that no human being could survive. Moreover the temperature indications furnished by the Weather Bureau find immediate practical application in many important industries, all of which, if the proposed measure should become law, would be obliged to make constant and vexatious use of conversion tables, or follow the Government's example and abandon the old scale for their own purposes.

Before considering what would be gained by substituting the centigrade scale for the Fahrenheit, it is worth while to point out that neither of these scales is an ideal one, nor, if our ancestors had taken the precaution of consulting us in regard to them, would either one have ever been adopted. In comparison with a scale reckoned from absolute zero, both are arbitrary and illogical. In point of utility, the Fahrenheit scale has some points of marked advantage over its rival. Although the German instrument maker's naïve expedient of fixing his zero at the lowest point reached by the thermometer in a certain Iceland winter has not had the desired result of eliminating negative values of temperature from meteorological records, it is undeniable that such values are far more frequent in records kept in centigrade than in those kept in Fahrenheit. Moreover, as the centigrade degree is nearly twice as great an interval as the Fahrenheit, records kept in the latter realize a proportionately higher accuracy, when carried to the same number of decimal places. In order to make centigrade values as accurate as Fahrenheit we must add a column of figures—often entailing a very serious increase in the amount of printing.

Of course the one strong argument in favor of adopting the centigrade scale for all purposes is that we should thereby secure uniformity, not only with other countries (Great Britain excepted), but between popular and scientific practice in our own country. This appears to be a very desirable object, when one considers the immense amount of labor that is now spent in the interconversion of scales, and one well worth the temporary inconvenience and expense that it would entail. But when we look more carefully into Mr. Johnson's plan, we find that the kind of international uniformity he proposes to attain is seriously qualified by the fact that he does not propose to adopt the metric system. He says:

"The metric system and the centigrade scale are two totally different subjects, and the attempt to yoke them together would merely create confusion. The essential advantage of the metric system lies in this, that it enables multiplication and division to be performed by the mere moving of the decimal point. This has nothing to do with the centigrade scale, because there is no occasion to multiply and very little occasion to divide degrees of temperature. Conversely, the essential advantage of the centigrade scale lies not in the division of the thermometric base into 100 deg., but in placing the zero at freezing point. This evidently has nothing to do with the metric system."

Just why is it more convenient to call the freezing point of water zero than to call it 32 degrees? Mr. Johnson has shown above that it is, for some purposes, decidedly less convenient, because leading to the more frequent use of negative quantities.

It is idle to speak of an "attempt" to yoke together metric and centigrade, because they are already yoked together in nearly the whole body of modern scientific literature. Tables and formulas of all kinds are expressed in centigrade-metric units, and these are, to a considerable extent, duplicated by tables and formulas in Fahrenheit English units. In other words, centigrade degrees of temperature are always used in conjunction with meters, grams, etc.; Fahrenheit degrees with feet, pounds, etc.

The National Advisory Committee for Aeronautics

A SHINING exception to Great Britain's failure, before the present war began, to enlist the services of her men of science in behalf of military preparedness was the appointment, in the year 1909, of an Advisory Committee for Aeronautics, the function of which was to give scientific advice to the aeronautical branches of the army and the navy. Under the presidency of Lord Rayleigh and the chairmanship of Dr. Glazebrook, this body has given a world wide impetus to the study of scientific aeronautics.

In the year 1913 a somewhat analogous body was formed in the United States, in connection with the reopening of the Langley Aerodynamical Laboratory of the Smithsonian Institution. This organisation was not, however, especially concerned with military aeronautics. The Advisory Committee of the Langley Laboratory included members designated by the Secretaries of War, the Navy, Commerce, and Agriculture, but also many persons appointed directly by the Smithsonian Institution. Ultimately the committee found itself involved in a legal tangle arising from the fact that the coöperation of Government officials in its work had not been authorized by Congress.

As a remedy for this situation there was inserted in the Naval Appropriation Act approved March 3rd, 1915, a provision for a National Advisory Committee for Aeronautics. The promoters of this undertaking frankly acknowledged the source of their inspiration by incorporating in the bill a description of the proposed committee that is taken *verbatim* from the initial report of its British prototype. Thus the report of the British Advisory Committee for Aeronautics for 1909-10 (page 5) declares the work of the committee to be "the scientific study of the problems of flight, with a view to their practical solution," and adds that "the committee are to determine the problems which the experimental branch should attack, and to discuss their solutions and their application to practical questions," while the bill, drafted in 1915, organising the American committee states that "It shall be the duty of the Advisory Committee for Aeronautics to supervise and direct the scientific study of the problems of flight, with a view to their practical solution, and to determine the problems which should be experimentally attacked, and to discuss their solution and their application to practical questions."

The act above mentioned authorizes the President to appoint not to exceed twelve members, consisting of two from the aeronautical branch of the army, two from that of the navy, one each from the Smithsonian Institution, the Weather Bureau and the Bureau of Standards, and "not more than five additional persons who shall be acquainted with the needs of aeronautical science, either civil or military, or skilled in aeronautical engineering or its allied sciences."

Nominally, the American committee has a broader and more humanitarian field of activity before it than the British. One of its rules, approved by the President last summer, states that it "shall exercise its functions for the military and civil departments of the Government of the United States, and also for any individual, firm, association, or corporation within the United States, provided, however, that such department, individual, firm, association, or corporation shall defray the actual cost involved."

Notes on the War

Italian Navy and Austrian Submarines.—It is reported that the Italian navy is actively engaged at the present time in running down the submarines of the Central Powers that have been preying on Allied commerce in the Mediterranean. The methods employed by the British in the North Sea are being followed by the Italians.

Americans in the U. S. Navy.—It is learned from Government statistics that the United States Navy constitutes the most thoroughly American body of men in the world. Of the 52,561 men aboard American war ships or serving on shore, 47,664 were born within the continental limits of the United States, and of the remainder 1,900 were born in the overseas possessions of this country.

Gaining Gun Power by Length.—The "California," "Mississippi" and "Idaho" are to be armed with a new type of 14-inch gun, which will show a considerable increase of power over the 45-calibre gun. The new piece is six feet longer in the bore than the 45-calibre 14-inch, and its velocity and energy have been greatly increased, the muzzle energy being something over 70,000-foot tons. Rear Admiral Strauss, Chief of Ordnance, states that these new guns are capable of penetrating the heaviest side armor at oblique impact at the greatest effective battle range. It is gratifying to learn that the new type of 16-inch, 45-calibre gun, built at the Washington Gun Factory, has fulfilled the highest expectations and that the Bureau believes it to be as powerful a gun as any in existence to-day.

U. S. Navy and Other Navies.—According to a report recently submitted to the House Naval Committee by Josephus Daniels, Secretary of the Navy, the ranking of the leading naval powers, based on such information as is now available, is as follows: Great Britain, Germany, United States, France, Japan, Russia, Italy, Austria, Spain, Argentina, and Brazil, representing a total of 137 dreadnoughts laid down prior to August 1st, 1914, and 25 dreadnoughts laid down or authorized since then. Since many of the belligerents are known to be building warships in secret, the last number is, in all probability, considerably greater. Dreadnoughts are now said to cost on an average $15,000,000 each, while some cost $12,000,000. Those now being built by the United States will cost in the neighborhood of $18,000,000.

The Zeppelin as an Offensive Weapon.—Basing its calculation upon the data which was procured when the Z-4 made a descent at Luneville, France, in 1913, "Aeronautics" estimates that the maximum capacity of the modern Zeppelin for carrying high explosives is about one and one half tons, and that they cannot possibly carry the five tons which have been claimed for these ships of the air. The same authority estimates that in crossing the 300 miles from the German base to the English coast, a ton and a half of fuel is consumed and that if a ton and a half of explosive is carried a static state of equilibrium will have been attained by the time the coast is reached, the lifting power thereafter being dependent upon the lifting planes. Explosive bombs carried by the Zeppelin weigh 185 pounds and the incendiary bombs about 20 pounds each.

An Offset to the "Audacious."—If the circumstantial dispatch from Rotterdam stating that one of Germany's newest dreadnoughts recently ran on a mine in the Baltic and sank be correct, the loss of this ship will fairly offset the loss of the British dreadnought "Audacious" off the Northwest coast of Ireland. The latest German dreadnoughts are those of the "Koenig" class, all of which are probably by this time in commission. The names of the vessels are "Kronprinz," "Grosser Kurfurst," "Koenig" and "Markgraf." In displacement, they are about the same as our "Wyoming," though in armament they are inferior, carrying ten 45-calibre 12-inch guns against the "Wyoming" twelve 50-calibre 12-inch, but they are better protected, having a 14-inch belt against the Wyoming's belt of 11 inches.

Armenian Civilization.—Travelers have recognized for centuries, says Sir Edwin Pears, that the Armenian population of Turkey, numbering about two millions, is a most valuable element in the country. The people, like ourselves, belong to the Indo-European race. A large portion of them occupy a mountainous country, and the men are usually stalwart and industrious. Their country was civilized and prosperous in the time of Christ, and I cannot doubt that the general average intelligence of Armenians is due to the fact that they are the descendants of parents who have been civilized for centuries. Armenia was the first country to establish Christianity as the religion of the state. Their great Christian teacher and national saint is Gregory the Illuminator. . . . It is rare to visit the house of an Armenian in a fairly prosperous condition where there is not evidence of artistic and musical taste: pictures or a piano, or other musical instruments.

Astronomy

The New Draper Catalogue.—At the meeting of the American Astronomical Society last August, Miss Annie J. Cannon reported that the classification of spectra for the new Draper Catalogue was completed except for a small portion of the sky, and that the work would probably be entirely finished and ready for the printer in October. On July 27th, 1915, the total number of spectra classified was 221,601, of which about 180,000 had been identified and entered in the card catalogue.

Legislation for the Preservation of Meteorites.—The *South African Journal of Science* records the steps that have been thus far taken, at the suggestion of the South African Association for the Advancement of Science, to secure legislation in various countries relative to the preservation of meteorites in the interests of science. The committees of Sections A and C of the British Association adopted the following resolution at the Australia meeting: "That in view of the fact that meteorites which convey information of world wide importance are sometimes disposed of privately in such a way as to deprive the public of this information, the council be requested to take such steps as may initiate international legislation on the matter." Since the Australian meeting this resolution has been accepted by the council of the British Association and transmitted to the International Association of Academies.

Photographs of the Zodiacal Light, gegenschein, and other large faint objects have been made by Prof. A. E. Douglass, who described his method as follows at the California meeting of the American Astronomical Society: Absolute freedom from city lights is essential. He uses a lens of large aperture and short focus, making a small picture, also a panorama mechanism with a curved film and a sort of focal plane diaphragm passing a curved opening across the front of the film. Multiple exposures, simultaneously or in immediate succession, are made on the faint object up to any number desired. These are all developed, then they are placed one above the other in careful registration and prints made from this compound negative. If necessary a similar compound positive is made, from which a final negative with any desired contrasts is obtained.

The Last Number of the Memoirs of the Lowell Observatory announces a discovery in connection with Saturn. This investigation by Director Lowell is concerned with the theoretic and observed positions of the recently discovered as well as the old divisions of the ring system. All of these divisions are caused by the perturbing action of Mimas on the particles of the rings. In consequence of their not quite agreeing with the theoretic positions an investigation was entered into which has succeeded in throwing new light on the internal condition and distribution of the matter composing Saturn's ball. The observed positions of these divisions can seemingly only be reconciled by a greater internal oblateness than has hitherto been supposed, which demands a greater speed in the kernel than the husk. Not the least interesting fact about this result is that measures on the rings should lead to a discovery about Saturn's internal constitution.

The Photoelectric Photometer.—Messrs. Jacob Kunz and Joel Stebbins reported at the last meeting of the American Astronomical Society that various improvements have been made during the past year in the methods of preparing photoelectric cells in the laboratory and their photoelectric photometer has been completely reconstructed. The effective sensibility of the instrument has thus been increased five or six fold. A year ago it was about equal in sensibility to the selenium photometer and could be used with a 12-inch telescope, for stars down to the third magnitude, but it can now be used in observations on stars of the fifth magnitude. The accuracy attainable with this instrument depends upon the brightness and position of the stars to be observed, but the authors claim that a probable error of ±0.005 magnitude may be easily obtained for stars of about magnitude 3.5.

Lady Huggins's Gift to Wellesley.—Although the late Lady Huggins, the wife and collaborator of the famous English spectroscopist and astronomer, was never in any way connected with Wellesley College, she took a keen interest in this institution, as an example of the intellectual opportunities for women afforded by the New World. This interest has been manifested in a striking way, for it appears that, in accordance with the terms of Lady Huggins's will, the American institution has become the owner of a large collection of her most personal belongings. These objects, which were recently placed on exhibition at Wellesley, include more than 700 books, besides pictures, furniture, artistic and historic jewelry, bric-a-brac, etc., and, of special interest, 12 small astronomical instruments, including the smallest spectroscope ever made—a wedding gift to Lady Huggins—and a spectroscope which belonged to the chemist Miller, who worked with Mr. Huggins when he first began to investigate the chemistry of the stars.

Radio Communication

Pope to Bless Wireless.—According to a report from the Rome correspondent of a prominent news service, Vatican circles announce that the Pope is preparing to bless wireless telegraphy officially, thus restoring the ancient custom of the Church to bless inventions which confer great benefits on humanity.

Portable Army Pack Set.—The Signal Corps of the United States Army is building a high power field wireless set with a sending radius of 250 miles. It can be knocked down and shipped in packages weighing 350 pounds, maximum. Furthermore, states the *Army and Navy Journal*, its parts are specially convenient for shipment, and can be carried by pack trains.

Proposed Government Radio Monopoly.—The last annual report of Captain W. H. G. Bullard, superintendent of the Navy Radio Service, contains a recommendation that the Government control and operate all coastal radio stations within the jurisdiction of the United States, in such manner establishing a practical monopoly for the transmission of all Government business. For some time there has existed considerable friction between the naval radio men and the wireless amateurs, and often the threat has been heard of late that the Navy is soon to control all wireless communication in this country.

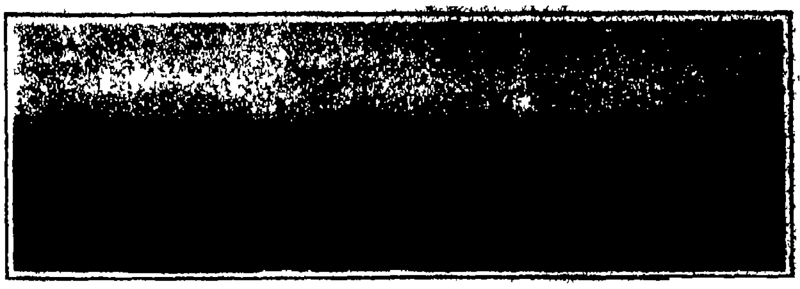
Three New Stations for U. S. Navy.—With the approval of the contract between the Navy and an American wireless company for the equipment of the radio stations at San Diego, Cal., Cavite, P. I., and Pearl Harbor, Hawaii, one of the final steps has been taken toward linking the United States with its overseas possessions. Not only will radio communication be possible between Washington and the insular possessions, but it will also be possible to send dispatches to almost any point in the world. The stations under construction at Pearl Harbor and Cavite will be the most powerful in the world, the continuous range of these stations being in excess of 4,700 miles.

Wireless Communication Between United States and Japan.—The Japanese government recently notified the Marconi Wireless Telegraph Company that the new station at Funabashi, near Tokio, was completed and would be ready for trans-Pacific communication at an early date. Experiments that have been going on between that station and Honolulu are reported to be most successful and no difficulty is being experienced in maintaining communication over the 1,400 miles that intervene. In some instances the Japanese station has been heard at San Francisco, a distance of 5,000 miles. The Funabashi station is rated at 300 kw. Were it not for the fact that Japan is engaged in war, the station would probably be in active service to-day.

Radio Station for the Society Islands.—According to an announcement made by the United States Bureau of Navigation it is learned that a powerful radio station has been built on Tahiti, one of the Society Island group, by the French government. The temporary station is of 10 kw. capacity and will be used until the permanent station is completed. The latter will have an aerial system supported by eight towers each 325 feet high, placed in two parallel rows of four towers each. Two antennae will be provided for two different wavelengths. It is expected that the permanent installation will be capable of working with Sydney, South America, Honolulu, San Francisco, Cochin China and even Martinique and Guadeloupe. On January 5th the temporary station on Tahiti was heard at San Francisco.

Commercial Extra First-Grade Licenses.—The United States Department of Commerce is now issuing a special license known as commercial extra first grade to radio operators, whose trustworthiness and efficient service entitle them to confidence and recognition. These licenses are given consideration by the Civil Service Commission in examinations for positions requiring knowledge of radio telegraphy, when experience is rated as part of such examinations. Applicants for this grade of license must pass a special examination. To be eligible for this examination they must hold commercial first grade licenses and their certificates of skill in radio communication issued under the act of June 24th, 1910, or licenses under the act of August 13th, 1912, must record 18 months' satisfactory commercial service at sea or at land stations, either or both, during the two years previous to the filing of the application for examination, as shown by indorsement on the license, service records or other satisfactory evidence, and provided that the applicants have not been penalized for a violation of the radio laws and regulations. A speed of at least 30 words per minute Continental Morse, and 25 words per minute, American Morse (five words to the word), must be attained. The technical questions and the questions on the radio laws and regulations are considerably wider in scope than those for commercial first grade, and a higher percentage is required.

Cross section of a German submarine of an early type



German submarine of an early type entering a harbor

Submarine Warfare

Early History of Underwater Craft and Their Recent Uses in Naval Activities

ALTHOUGH much had been expected of the submarine it cannot be denied that craft of this type have fully met if not exceeded expectations. On second reflection this statement stands amendment. It is perhaps more logical to state that in purely naval engagements, i. e., in warfare against recognized armed vessels the submarine has not accomplished what had been expected of it, but on the other hand its versatility in penetrating underwater barricades in bombarding land works and troops and in warfare on unarmed merchantmen has been truly startling and, indeed, a revelation.

The submarine, although recognized as a later day instrument of warfare, dates back much further than is generally believed. Leaving out of account the early attempts of a Dutch physicist in 1620 and those of the Englishman Symons in 1747, it may be a surprise to many Americans to learn that the first submarine attack was undertaken in the War of Independence. In 1775 David Bushnell, an American patriot, constructed a crude vessel of wood which was manually propelled. Behind the vessel was a magazine containing about 150 pounds of powder and a clock-work exploding device. In marked contrast to present-day practice, in which the submarine accomplishes its destructive errand by discharging a self-propelled mine or torpedo against an enemy vessel, the magazine of Bushnell was attached to the hull of an undesirable ship by means of a cable terminating in a wood screw. It was thus kept in position until the explosion took place some time later. Bushnell carried out a submarine attack on the British warship "Eagle," and although he succeeded in maneuvering his craft under the unsuspecting enemy, he failed properly to attach the mine or magazine to the bottom planking of the "Eagle," with the result that the explosion took place about an hour later at some distance away from the intended victim and without causing any damage to the enemy.

Although Bushnell's attempt was not successful, it held much promise, and for that reason it was not lost sight of. Robert Fulton, who built the famous steamer "Clermont," offered Napoleon a submarine of his invention for the contemplated invasion of Great Britain, and a German engineer, Wilhelm Bauer, in 1850 came forth with plans for a submarine by which, to use the words of Burgoyne, an English writer on maritime subjects, "the solution of the problem of submarine navigation was promoted to a higher degree than any other inventor."

Wilhelm Bauer, constructor of the first German submarine, was born in 1822 at Dillingen, Bavaria. He took part in the German-Danish war during 1849 as an artillery man of the Schleswig-Holstein army. Thanks to financial help extended to him by the army and navy authorities as well as by private persons, in 1850, at Kiel harbor he was able to put into practice his ideas relating to the construction of a submarine. His craft was intended for use against the Danish warships then blocking German harbors, but it never made an attack on the enemy fleets. In connection with an experiment in Kiel harbor in 1851, the vessel foundered, but the crew was saved. Thirty six years later, in 1887, the submarine was salvaged in connection with the construction of a torpedo harbor at Kiel, and at the present time the remains of Bauer's submarine rest in the courtyard of the Berlin Marine Museum.

In 1883, the Swedish engineer, Nordenfeldt, built a submarine boat at Stockholm, which might well be considered as the immediate forerunner of the underwater craft of the present day. This vessel had a length of 64 feet and a displacement of about 60 tons, the propulsion being furnished by a steam engine of 100 horsepower. When running submerged, steam stored in large tanks together with that in the boiler served to drive the engine, the fire under the boiler being allowed to subside before submerging.

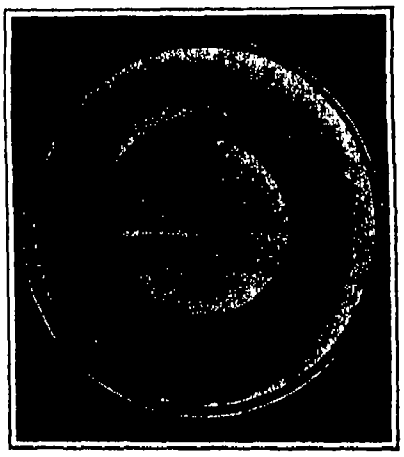
Since Nordenfeldt's submarine, the problem of underwater navigation has been given careful consideration by the leading naval powers. The French marine authorities are recognized as having been the first to undertake methodical tests intended to promote the development of the submarine boat. Other naval powers followed suit, rather slowly at first, but more energetically later, with the result that the underwater craft was rapidly developed from an experimental craft to a practical weapon of attack. Among the last to take up submarine construction was Germany. According to German naval men, there was no harm in maintaining a wise reserve while other nations were spending time and money in costly experiments. Thus it was that the German navy began to concern itself with the submarine as a naval weapon as late as 1905, and it must be admitted that the present war has proved the excellence of their underwater craft as well as the skill of their crews.

A modern submarine boat, to be really effective, should be especially sea worthy not only in the sense of surface navigation, but also in being able to withstand tremendous water pressure encountered when submerged even a slight distance below the surface. The problem of propulsion is one of the most important. In practically all modern submarines, gasoline or oil engines are used when on the surface, while electric motors and accumulators are depended upon for submerged navigation. A speed of 10 or 11 knots is ample for submerged navigation but, while traveling on the surface speeds of 18 to 20 knots are attained by the latest German submarines. The radius of action, with out replenishing the oil tanks, is as high as 5,000 to 7,000 in the most recent models.

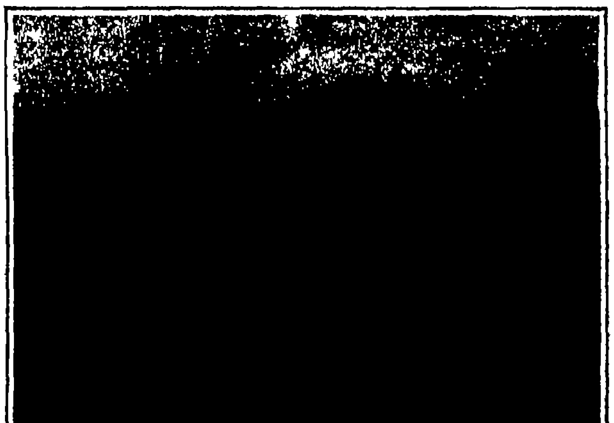
The torpedo is to the submarine boat what the projectile is to the gun. It is accordingly essential that each craft must carry a sufficient supply of torpedoes to be effective against enemy ships. Each of the latest type of German submarines is ordinarily supplied with 10 or 12 torpedoes, which may be discharged through six torpedo tubes—four ahead and two astern—thus permitting of their discharge in quick succession if necessary.

The diving power of the submarine is, of course, of the highest importance. Sufficient water having been admitted into tanks to cause the boat to submerge until only the conning tower protrudes above the surface, the horizontal rudders are manipulated to overcome the last traces of buoyancy, whereupon the craft plunges to any depth, within certain limits, that may be necessary. In order to again rise to the surface, the water is driven out by compressed air and the horizontal rudders manipulated.

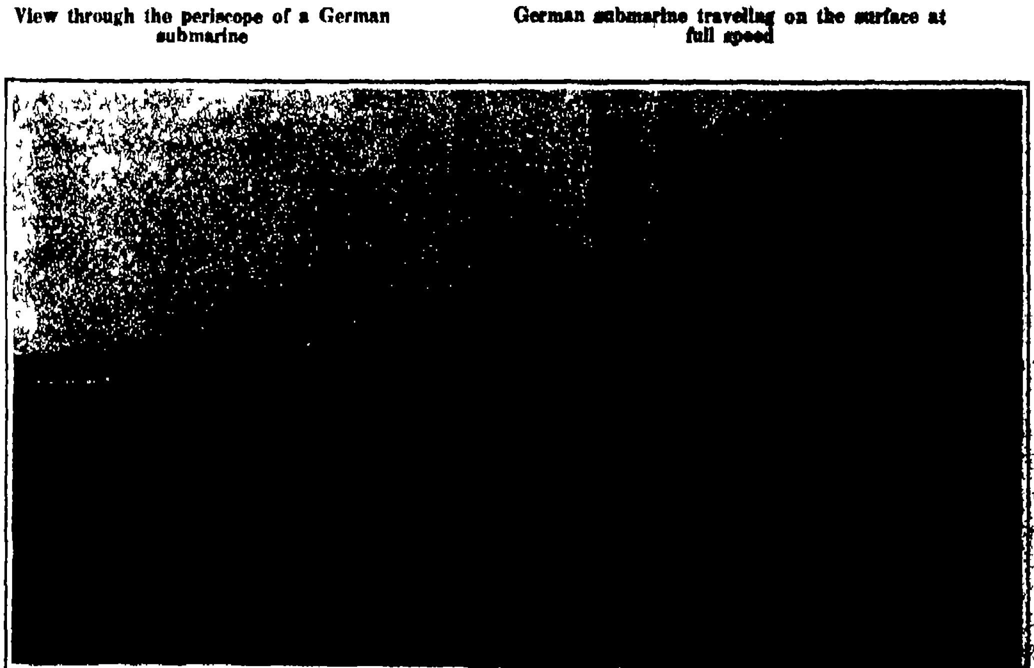
When running entirely submerged, a submarine is practically blind; that is to say, the pilot cannot see because of the darkness of the surrounding water, and is accordingly obliged to lay his course entirely by compass and chart. However, when running partially submerged, or even at a depth of a few feet, it is possible to obtain a view above water through the agency of an optical device known as a [illegible], consisting of a tube carrying at the upper end a system of mirror prisms, which reflect the [illegible] through the tube to the lower [illegible] interior of the submarine. [illegible]



View through the periscope of a German submarine



German submarine travelling on the surface at full speed



Four German submarines or U-boats with their mother ship in a seaport

[illegible] to obtain a view of the entire horizon, [illegible] craft entirely hidden below the water, barring the single exception of one or two periscopes measuring but a few inches in diameter

Service on board a submarine is extremely trying. In fact, it places a perpetual strain on the mental capacity of the crew because of the complexity of the manifold apparatus and machinery, gages, periscopes, compasses, delicate instruments and other devices. Even a slight mistake is at times liable to result in the death of the entire crew Aside from the mental strain, the lack of exercise and the poor air are but two of the conditions which try the strongest constitutions.

Aside from the remarkable exploits of British submarines in the Baltic Sea and in the Sea of Marmora, the Germans have proved to be the masters of under-water navigation in the present war Although the Allied forces were slow to make use of their submarines in the earlier months of the great war because of the scarcity of enemy ships on the high seas, they have since become very active, not only in the Baltic, but also in the closed in body of water, the Sea of Marmora, which has been reached by diving below netting and mines which the Turks placed across the western entrance to this waterway

No more interesting account of the high degree of perfection attained in modern submarines, both in material and personnel, could perhaps be offered than the experiences of Naval Lieut.-Commander Wenninger, commander of the German submarine U-17 (which torpedoed the French steamer "Graveline"), during a recent raid in which his craft became caught in a net of an English boat off the coast of England Here is the way in which he told the story to a representative of the American press

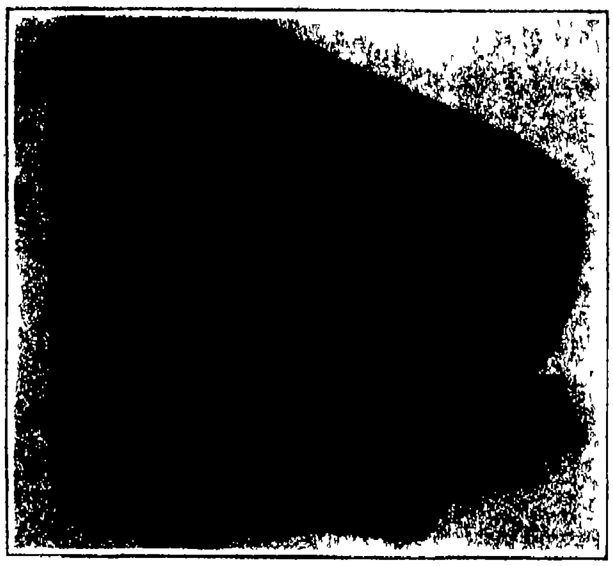
He said that they left their base early in the morning and passed into the North Sea, the boat being under water, with the periscope awash. "I looked through the periscope," he continued, "and could see a red buoy behind my boat When, ten minutes later, I looked I saw the buoy again, still at the same distance behind us. I steered to the right and then to the left, but the buoy kept on following us. I descended deep into the water, but still saw the buoy floating on the surface above us. At last I discovered that we had caught the chain of the buoy and that we were dragging it along with us. At this time I also saw through the periscope that a strange, small steamer was steering a course directly behind us and the buoy At the same time my sounding apparatus indicated that a screw steamer was in the vicinity Observation revealed that five enemy torpedo-boats were approaching from the north I increased the speed of the boat in the expectation of being able to attack one of them. The five torpedo-boats arranged themselves in a circle. I sank still deeper and got ready for eventualities.

"At this juncture my boat began to roll in a most incomprehensible manner We began to rise and sink alternately, the steering gear being apparently out of order Soon afterward, I discovered that we had encountered a wire netting and were hopelessly entangled in it. We had, in fact, got into the net of one of the hunters surrounding us.

"For an hour and a half the netting carried us with it, and, although I made every effort to get clear of it, it seemed impossible. There was nothing to do but to increase the weight in the submarine as much as possible so that I might try to break the netting. Fortunately, when we started I had pumped in from five to six tons of water, filling all the tanks. I increased the weight of the boat to the [illegible] and suddenly we felt a shock and were clear of the netting. I then descended as deeply in the water as I could, the manometer showing 30 metres. We [illegible] under water for 15 hours. When I wanted to [illegible] where we were, I noticed that my compass [illegible] of order. For a time I steered by the [illegible] but at last I had to get rid [illegible] I now discovered that the manometer continued to register the same depth, and was also out of order I had therefore to be very careful not to rise too high and thus attract the attention of the torpedo boats.

"Slowly the periscope rose above the surface and I could see the enemy in front of me and toward the left the east coast of England. I tried to turn to star board, but the rudder did not work. In consequence I had to sink again to the bottom of the sea where I remained for six hours, at the end of which time I had succeeded in putting the compass in order and also in repairing the steering gear But upon rising this time we were detected by a torpedo-boat, which made straight for us, forcing me to descend again I remained submerged for two hours, then turned slowly outward, and, a distance of some 50 metres from the leading enemy craft passed toward the open sea At nine o'clock in the evening we were able to rise to the surface in safety"

Thus has the submarine boat been perfected

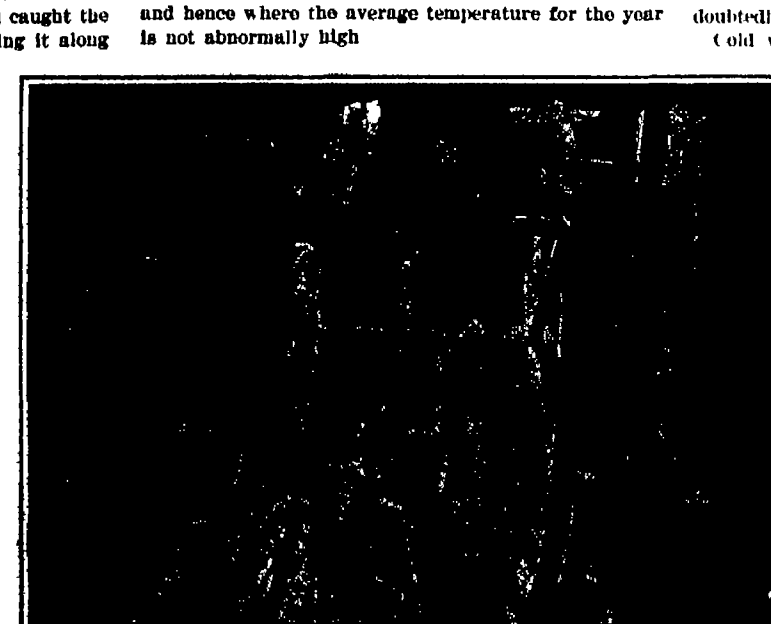


Exterior view of the first German submarine, now resting in the court yard of the Berlin Marine Museum

Wilhelm Bauer, constructor of the first German submarine boat

The Hottest Region in the World

BEFORE attempting to answer the question, "Which is the hottest region in the world?' it is necessary to define one's terms. Does this inquiry refer to the region having the highest average temperature throughout the year, or to that in which the highest temperatures occur at the hottest season? It so happens that the most remarkable extremes of heat are attained in regions having a rather wide range of temperature, *i e*, where it is not hot all the year around, and hence where the average temperature for the year is not abnormally high



Interior view of the first German submarine, showing the pedals and gears by which foot power was applied for propulsion purposes

The question stated above is a common one, and probably in most cases the person who asks it has in mind a comparison of maximum rather than mean temperatures. Assuming the question to be asked from this point of view, the answer to it will no doubt surprise most American readers. So far as can be learned from observations made at regular meteorological stations, the hottest region in the world is not in the heart of Africa, or South America, or even in the torrid deserts of Asia—but in the United States of America

On the eastern edge of Death Valley, California, a certain borax company has laid out a ranch embracing some 100 acres of irrigated land, on which are grown alfalfa, fruit and vegetables Although it has been stated on excellent authority that you cannot hold a fire in your hand by thinking on the frosty Caucasus, the owners of the above-mentioned property doubtless had an analogous expedient in view when they named their estate "Greenland Ranch

In the spring of 1911 the Weather Bureau established a coöperative station at this place and the results of the observations made here during the subsequent four years are discussed by Mr G H Willson in the current number of the *Monthly Weather Review* The thermometers are installed in a standard screen, placed over an alfalfa sod about four feet from the ground The shelter is not exposed to the reflected heat of the desert The location is about 178 feet below sea level

On July 10th 1913, the maximum thermometer at Greenland Ranch registered 134° Fahr the highest "shade temperature ever recorded at a meteorological station anywhere in the world, and four degrees above the previous "record observed at Mammoth Tank also in California on August 17th 1885 Outside of the United States the record for a regular meteorological station appears to be 127° Fahr which occurred at Wargla Algeria, on the edge of the Sahara Desert August 27th 1884

During the hot spell in which this extraordinary temperature was measured at Greenland Ranch, the daily maxima were as follows 8th 128°, 9th 129° 10th 134°, 11th, 129° 12th 130° 13th 131° and 14th 127° Throughout this frightful hot wave the temperature never fell below 85° Fahr

The records made at this station during the past four years show that temperatures reaching 100 or more have occurred on 548 days and may be expected at any time from April to October, inclusive the highest occurring in July or August Temperatures of 120 or more have been recorded in May June July and August In July and August the average daily maximum has always exceeded 110°, while in July 1911, it was 117° In July 1914 the mean temperature for the month (*i e*, half the sum of the mean maximum and mean minimum) was 101 0° Yet Mr Willson tells us that in the lower valley bottom higher temperatures undoubtedly prevail than at the meteorological station!

Cold weather is not unknown at Greenland Ranch Minimum temperatures of 32° (freezing) or below have been recorded in November December January and February On January 8th 1913, the temperature fell to 15° Fahr

Heat and Magnetism

AT a recent meeting of the Société de Physique Mr Cotton read a paper upon the rapid disappearance of the magnetism of iron at a red heat and illustrated this action by an experiment in which the effect was readily seen A long aluminum tube is arranged so as to swing freely from a pivot support at the top end and means are provided to limit the swing by a stop piece At the lower end of the tube is a curved platinum wire carrying a sheet iron plate at one end The device is placed near the poles of a strong magnet so that the tube or pendulum swings towards the magnet owing to the attraction exerted on the iron plate and the pendulum is thus drawn to the limit of its swing The flame of a large Bunsen burner is placed so as to entirely surround the iron plate when in this position and when the plate reaches a red heat it loses its magnetic properties and ceases to be attracted so that the pendulum now falls down to the zero position When the iron plate cools down it resumes its magnetic properties and is again attracted by the magnet so that the plate enters the flame and becomes heated and so on In this way the pendulum is made to keep up a constant swing On this principle the loss of magnetism by heat can be made the basis of a device which furnishes motive power though in a small amount in the present case. This should not be considered as perpetual motion, however since heat is required.

Industrial Preparedness for Peace

II. Making a Study of My Business

By Miner Chipman

THE SCIENTIFIC AMERICAN'S campaign of Industrial Preparedness for Peace has for its purpose to awaken the nation to the urgency of immediate preparation for the competition we are sure to encounter when production takes the place of destruction in Europe. The campaign was launched with an article by Miner Chipman, in the issue of January 15th, on "The Meaning of National Efficiency." This is the second of Mr. Chipman's series. Following it, on the next page, is an article by George W. Perkins, on Germany's preparedness, not only for war but for peace, as well. An illustration of our dependence on Germany, and what steps we are taking to liberate ourselves, will be found in Dr. Thos. H. Norton's article on "The Potash Famine," which appears on page 146.—EDITOR.

I HAVE received a number of letters from business men relating to our campaign for Industrial Preparedness for Peace. There seems to be one question which bothers the manufacturer and merchant more than all others, and that is this: "How can I prepare when I do not know what I am preparing *for?*" In other words, how is the American business man going to be able to develop adequate plans of offense and defense in a commercial sense if he does not know the conditions under which he will be called into the fight for business supremacy? At first glance, this appears to be a very reasonable question, but in reality it is entirely beside the issue. If we knew just exactly what is going to happen, when it will happen, and how it will happen, there would be no need for any hue and cry for industrial preparedness. It has been a favorite saying of American business that we should never cross a bridge until we come to it. We haven't. At times we haven't crossed a bridge when we came to the point where a bridge ought to be. In many respects American business ideals are like American legislative ideals: hindsight and not foresight. We are a great people for investigating. Unfortunately our investigations are usually *ex post facto*. If a factory burns and many lives are lost, if a ship sinks or turns turtle, if anything *unforeseen* happens—we must have an investigation. We are not going to cross any bridges before we come to them, but we are going to *know* that bridges *exist* at the points where we may urgently require them.

A little while since a man from a small middle-west town was telling me about the fire department in his home city. Following a very disastrous fire, the city fathers became suddenly progressive, and had a very modern and complete water system introduced. A volunteer fire department was organized, and upon summer evenings the people of the town were entertained by the fire department's activities in "washing down" the dome of the county court house. In a number of minor fires the new equipment proved to be effective. Time passed. No fire of any importance occurred. The fire department grew lax in practice and attendance to the monthly meeting in the council chamber. One night in the middle of February a fire broke out in the boiler room of the saw mill. The whistle blew, the volunteers gathered and dragged the hose-cart through the snow to the nearest hydrant. The unexpected happened. The hose burst. Long disuse, old age, decay, these things allowed the fire to spread with terrific rapidity. Half the town was destroyed. Preparedness gone to seed! A typical American habit.

There is a great deal of very indefinite talk about our problem of industrial preparedness. We have certain favorite topics of discussion. Since the beginning of the war in Europe we have heard a great deal about the aniline dye situation. In the press and upon the platform it is used as a powerful example of America's unpreparedness. Unfortunately, this situation is also *ex post facto*. The development of aniline dyes required intensive study, elaborate and patient laboratory research, and years and years of careful commercial development. Germany stands supreme in the aniline dye market because of her industrial preparedness 25 or 30 years ago. At the present time we can look upon the aniline dye situation in the same manner as we look backward upon the "Eastland" disaster and make a vow that "it will not happen again." The real reason why Germany has a monopoly in the aniline dye market is not inherently commercial in nature. It is found away back in the national ideals of the German people. Technical education, and support and encouragement of technical research, these things were the fundamental causes of German advancement in the chemical trades. Mr. James Armstrong very vividly points out to us the national characteristics of the German in their policy of commercial preparedness in his paper appearing in the "British World's Work," reprinted in the SCIENTIFIC AMERICAN for the week of January 29th, 1916. The real problem of American Industrial Preparedness does not lie in the direction of those things which have been neglected so long. We must look toward new opportunities, we must strengthen our weakest places, and build anew upon the experiences and lessons drawn from the European war.

America leads the world in certain lines. We stand in the machine-tool trade as Germany stands in the aniline dye industry. We are world leaders in the manufacture of automobiles. American railroad practice is second to none. We have proven our ability to pioneer, survey and build into unknown fields. Industrial preparedness for peace, if it means anything at all, means an extension of that particular ability. We may look for slight gain in commercial supremacy by any advantages to be taken of the present conditions. We do not know what will happen after the war. A large number of men with whom I have been in correspondence believe our chief danger lies in the "dumping" of products into American markets. This may be true, but the object of this campaign for Industrial Preparedness for Peace lies much deeper than the immediate effects of a declaration of Peace. We are looking toward the long years of reconstruction and readjustment of world markets. Where will the United States stand at the show-down? That is the question that is bothering us.

American industry is altogether too complex and varied in its nature to permit us to deal with a particular and individual problem. It is our object to get the vast field of little business, that great body of business enterprise which forms the backbone of our commercial life, thinking and working in the direction of adequate industrial preparedness. The great corporation with its limitless resources, has available for immediate use the laboratories, chemists, experts and specialists in all lines. This paper is written particularly for the business man whose volume of business, and financial resources do not permit him to make elaborate and intensive studies of markets, efficiencies and business conditions. The outline is not intended as a scientific basis of economic investigation. It is merely a skeleton of thought, about which the average business man may build the foundation of his future policies.

The Industrial Editor of the SCIENTIFIC AMERICAN will be pleased to receive comments and suggestions relative to this Survey, and answer such questions as he will be able to answer. It is our desire to coöperate with American business in the development of a national Survey and, within our limited means, will do our utmost to serve effectively.

If our business man will sit down for an evening with the following outline before him, and assign to different members of his organization particular subjects to report upon, and get his associates in business working with him upon the problem of industrial preparedness, we have made a very encouraging start. Answers to the questions must not be superficial. Each man must assure himself that he has exhausted his means of communication. He must dig down to the bottom, if possible. If he does not go to the bottom, he must know with a degree of certainty how far he has gone. If this preliminary survey accomplishes nothing more than a realization of the factors within the problem, we will be quite satisfied with the result.

The Survey

Every business may be divided into the following general factors:

1. Ideals and policies.
2. Personnel.
3. Plant and equipment.
4. Materials.
5. Processes.
6. Distribution.

This classification is empirical, and is not intended as a scientific analysis of business relations. I have divided the problem into these factors for purposes of discussing Industrial Preparedness for Peace.

Ideals and Policies

Back of every business we have the ideals of the individual or individuals who are operating the business. They are trying to do something. The term business is a general one, applied to the operation of putting these ideals into action. Upon the basis of these fundamental ideals a business man evolves certain policies of business conduct. From an efficiency point of view, it is essential that we analyze the ideals and policies of a business to determine whether or not they are properly co-ordinated, and are working themselves out in actual practice. The following questions will serve as a basis for such determination:

1. What am I in business for?
2. What is my business?
3. What have I to work with?
   - (a) Capital.
   - (b) Men.
   - (c) Materials.
   - (d) Customers.
4. What were my ideals when I started in business?
5. What were my policies?
6. How have they worked out?
7. What changes have taken place in ideals and policies?
8. Why the change?
9. Have I changed my ideals and policies in proper relation to the changing conditions of business?
10. Am I sure about it?
11. What are the present policies of my business? As to
    - (a) Capital.
    - (b) Plant and equipment.
    - (c) Human relations (organization).
    - (d) Processes.
    - (e) The sale of my product.

Personnel

The peanut man on the corner is distinctly an individualist. He and his peanuts constitute all there is to his business. He is the organization. In ever-widening circles, from the peanut man to the United States Steel Corporation, there are organizations of men and women directed by certain ideals and policies of commercial and industrial endeavor. The essentials of success to be found in the peanut man and the Steel Corporation are identical. The difference is one of numbers and not of nature. The wise peanut man figures out the best place for his cart. He goes there and establishes himself. He gets business and makes money. The United Cigar Stores Company did the same thing on a more elaborate scale. The problem of *Personnel* deals with the human relationships within a business. An organization is made up of people. A man or a woman in a business institution are parts of a great human machine. If we will examine our organization in the same manner as we would look into the mechanism of our typewriting machine, we will discover the necessity of knowing something definite about *Personnel*. A good typewriter is not constructed and sold upon the basis of *how many* parts there are in it. The purchaser of a typewriter is essentially interested in how well, and how efficiently, the writing machine performs the functions of a typewriter. Every part of the machine is designed for a particular purpose, and contributes toward the general efficiency of the whole. Our business man should have a very adequate grasp of the make-up, relationship, and functioning of his organization.

(1) What kind of an organization exists within my business?

(2) Can it be charted in definite form, showing functions and relationships?

(3) Is that organization properly co-ordinated with the process and procedure of my policy of doing business?

(4) How does my organization, in type, and in personal characteristics compare with that of my competitors?

(5) Is my organization the most effective form of organization?

(6) What other forms of organization are successfully operated?

(7) What are the advantages of my own type?

(8) What are the disadvantages?

(9) What changes are advisable?

Plant and Equipment

Every business must have plant and equipment. The peanut man may operate with a two-wheeled cart, and the railroad with its vast holdings of real-estate, terminals, and rolling stock. A business should have no more, and no less, plant and equipment than that required efficiently to carry out its policies of operation. Each and every item of capital invested should be placed for its most effective productiveness. There are efficiencies of *dollars* as well as efficiencies of *men*. An inlaid rosewood peanut cart would be an attractive thing upon the street corner, but its efficiency as a means to sell peanuts would be questionable. One of the most glaring inefficiencies of American industry is *over-equipment* We are over-equipped in machines and men in many lines of our industrial activity The economic effects of this over-equipment are tremendous. This inefficiency is measured in the terms of Dollars . dollar efficiency, and not in the units of production. One of the greatest errors in computing the *cost of production* is that of improperly distributing the wastes of inefficient investment. We figure costs upon the basis of *what is*, rather than upon the basis of *what ought to be* As a result, we revolve in a vicious circle, and never know our potential possibilities for improvement. From the viewpoint of preparedness for peace, we should look into our plant and equipment in the following form

(1) What have I invested in plant and equipment?
(2) Is it up-to-date?
(3) Under what disadvantages do I labor because of obsolescence?
(4) What is the most modern and efficient type of
 (a) Building and layout for my business?
 (b) Machinery for my particular processes?
 (c) Tools, jigs, and fixtures for the operations involved?
(5) What is my present output?
 (a) Per machine?
 (b) Per department?
(6) What should my output be?

Actual output divided by what the output should be will give you a figure showing your relative efficiency

(7) What would my possible output be with the most modern type of machinery and equipment?
 (a) With the same investment?
 (b) With an increased investment?
 (c) With a lessened investment?
(8) How do I stand in relation to my competitors?

Materials

Let us examine the problem of materials utilized in my business in the following manner

(1) Make a list of all materials purchased.
(2) Make a comparative statement showing
 (a) Amount in value, and per cent of total
 (b) Amount in units of weight or other unit of measurement, and per cent of total.
(3) Sources of these materials
 (a) Point or origin.
 (b) From whom purchased.
 (c) Price range
(4) Characteristics of materials
 (a) Chemical standards.
 (b) Other standards
(5) What materials are the most difficult to procure in the quantity and quality desired?
(6) Why?
(7) What remedies present themselves?

Processes

The best way to examine your business as a whole is by the aid of a Process Chart. This chart is made up of a sequential arrangement of materials, machines, and the human element in your business. In the experience of the writer, a process chart has been the most effective means of quickly discovering the important relationships between the *factors* of a *business*. Take your pencil and make a circle for each item of material that you use in the process of manufacture. Arrange these circles along the top of a large sheet of paper Group the materials as they are related to each other in your process. Drop a line down from each item, and in a small circle indicate how, or in what form, this material is tested. In a series of circles indicate the points where these materials are worked, brought together, or any operation which brings about a change in their nature. Continue this grouping until you reach the point where the materials have been created into a finished product. No matter how complicated and varied your business may be, you will be able to draw a diagram in this manner, which will show you the general process of your business. If you have colored pencils, it will be helpful to indicate machines in one color, and men, women, or children in other colors. Different machines may be indicated by different signs or symbols. As you develop this chart, you can definitely place each and every item of plant and equipment. Every member of your organization can be shown upon this chart, and their responsibility shown in the terms of process and materials.

The making of a complete process chart is one of the finest efficiency tests for an organization. *It is, at times*, very remarkable how indefinite the idea of the process of business is to even the general manager of a large business. He has a certain grasp of the thing as a whole, but is totally unable to chart the process step by step without a great deal of revision, conference, and checking up. In a large paper mill, which had been *operating for* a great many years, it required several months to prepare an accurate process chart of its operation.

When you have completed this chart and checked it up from every angle, it will be wise to look a little further and discover how your process chart compares with the best practice in your particular line of business. Turn your process chart over to the chemist in your laboratory and let him render you a report upon it Put it up to him to advise you as to possible economies and better methods of production Turn a copy of it over to your mechanical department and request them to report to you in the same manner Give as many men in your organization as time and opportunity will permit, a chance to report upon it, for betterment and efficiency

Distribution

The problem of distribution will be treated in a subsequent paper upon this subject. It is a problem equal in importance, and in many cases of greater importance, than that of production It is best that we have a very thorough knowledge of our manufacturing processes and opportunities, and then make an adequate examination of how we may profitably dispose of our product.

Germany's Example in Preparedness

By George W Perkins

IN considering the question of preparedness, the men of this country should be extremely careful not to allow themselves to think of it in one single groove viz., in a military sense—that is, preparedness measured simply in terms of battleships, forts, soldiers, and munitions.

I believe that in our discussions of the day we are too apt to think of the word ' preparedness ' in the narrow sense of meaning war munitions only, whereas as a matter of fact, preparedness " means three things preparedness in war munitions, preparedness in industrial equipment, and preparedness in leadership

Take Germany as an illustration Well informed Americans know that Germany is equally prepared in war munitions, in industrial equipment and in leadership The real marvel in modern Germany is not her military organization or her war munitions, but her industrial organization and efficiency For a quarter of a century she has been mobilizing her industrial resources getting away from the old notion that competition is the life of trade and moving forward to the newer belief that coöperation is the life of trade. This has enabled her to mobilize her industries, so that in times of peace they could be used to save the waste improve the efficiency, and in every way better the condition of her domestic merchants her export merchants, her agricultural and laboring classes The result has been that Germany's laboring class has been better housed better clothed better fed in recent years than the working classes of many other countries This has made her people loyal and patriotic and welded them into one united body which feels that there is something in their country worth fighting for Consequently, when this war broke out her industrial fabric was well knit and easily mobilized and brought to the support of her military organization With this in mind it is easily understood how Germany has been able to send one great army far into Russia, another into France, another into Belgium, another to the Dardanelles and clothe and provision them without a serious hitch anywhere.

In the matter of leadership Germany is equally well prepared The best minds in Germany give a considerable percentage of their time to public service. They are not all just mere money grabbers, bent on making every last cent they can out of anything and everything, to be used for their own personal, selfish satisfaction and enjoyment. The German men, having all in their youth received military training, learned early to think of their country and their government as something that belonged to them, something of which they were a part and to which they owed a duty This is so ingrained in the German youth that he never gets it out of his system, and, therefore, when he reaches *manhood it is* quite natural for him to feel that he owes to his country a certain amount of service just for the sake of service.

This has given to Germany a leadership in business and in statesmanship that is unique among the civilized nations of the world. It has given that country the service, in a loyal, patriotic spirit, of the best minds of the country

When we come in this country to the consideration of preparedness as we now do it behooves us to consider it in the same broad all around sense as Germany has, and I *fear* we are not considering it in any such way In discussing preparedness nowadays, nearly all the talk one hears has to do with the number of battleships we should have how much larger standing army we should have whether our forts are up-to-date or obsolete, etc This of course, is all very well but it is only all very well so far as it goes and in my judgment, it goes only one third of the way for we have got to be as well prepared industrially as we are in a military sense, and above all, we have got to be prepared in leadership—leadership that will stand uncompromisingly for our institutions and our ideals indeed being prepared in leadership is the most important preparedness of all

The war now on in Europe is bound to open up a great new world of thought and action Old theories and old precedents are going to be consigned to the scrap heap A reconstruction period in world thought and action is before us Improved inter-communication has wiped out State lines and National lines The man with the airship will be no respecter of boundaries The problems of one country will be the problems of all countries To cope with this entirely new situation we must produce an entirely new type of statesmen—men capable of thinking and acting not within the limits of a precinct or a state, but in terms of the nation and the world The day may come when we will need volunteers at arms—the day is already here when we need volunteers for public service—men who are willing to make a sacrifice, men who will enter public service as they enter military service, in an unselfish, patriotic spirit prepared to forego something to give something, actuated by a deep conviction that they owe a duty to the country of their birth or adoption Only through such inspired leadership can our country occupy its proper place in the new world movement that is so rapidly unfolding

"Strays" in Wireless Telegraphy

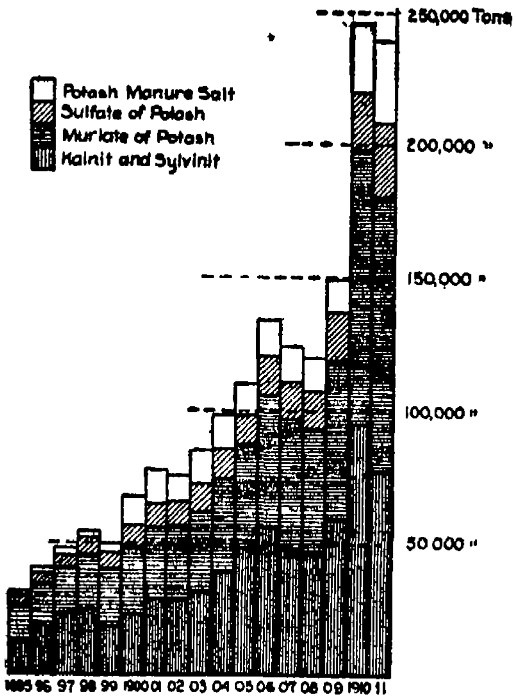
EVERY wireless operator is only too familiar with the erratic and troublesome noises in the telephone receiver of a wireless station, or the equally confusing marks on the tape of a coherer and inker set, due to natural electric waves, and variously referred to as "atmospherics," "static," "strays," "X's," etc The nature of these phenomena is not yet fully understood, and they have, accordingly, been made the subject of extensive investigations by a committee of the British Association. The name of Dr W H Eccles, who serves as secretary to the committee, has been especially identified with this field of research

Shortly before the beginning of the European war the committee in question undertook to collect statistics *on the occurrence of 'strays" at wireless stations* throughout the English speaking world and in a few other countries Although this programme was interrupted by the war, a certain amount of material was collected during the period from April to July, 1914, and some interesting results deduced therefrom were presented at the recent meeting of the British Association in Manchester

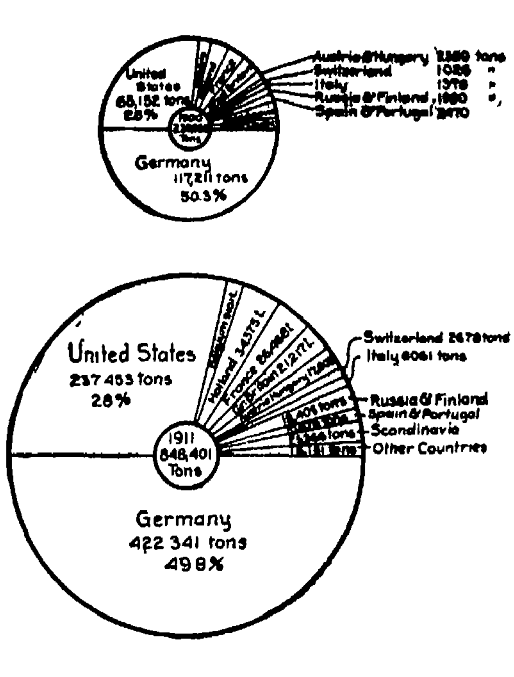
The principal and most generally reported fact is that the strays heard in the dark hours are much more numerous and louder than those heard during daylight. Curves have been drawn for various stations showing the amount of disturbance to radiotransmission from hour to hour, and these curves are found to be of two types, one in which the changes from day to night and night to day conditions are somewhat abrupt, and another in which they are more gradual The lowest point of the curve usually falls a little after midday, and the highest a little after midnight, at stations north of the equator The shape of the curve is greatly affected by local meteorological conditions.

Periods of excessively violent and frequent strays, rendering radiotelegraphic work almost or quite impossible, are called "X storms ' Periods of severe strays coincide with periods of low barometer, high wind velocity, rapid change in temperature great rainfall, and especially rapid barometric fluctuations In short, X-storms occur in connection with vigorous convective disturbances in the atmosphere, and the committee suggests that they may frequently be due to local weak electrical discharges accompanying such disturbances and not necessarily to distant and more violent discharges—i. e, lightning—as has been supposed

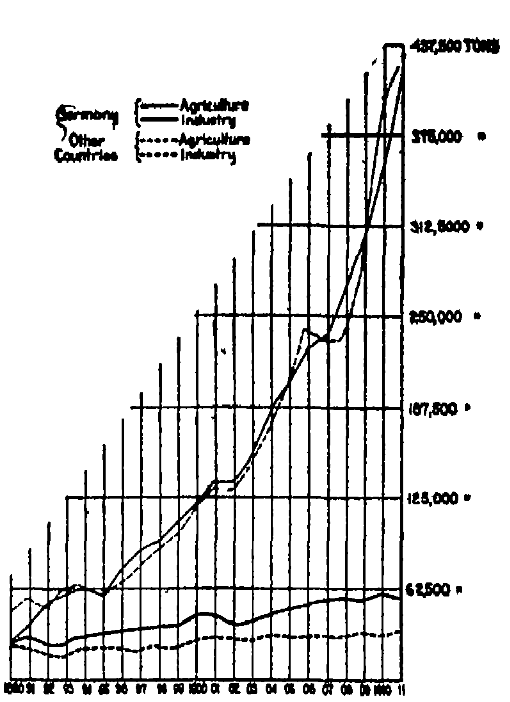
There is another type of X-storm, which occurs simultaneously at stations as much as 2 500 miles apart and is evidently not connected with local weather conditions. The committee has not yet investigated these storms but Dr Eccles and others have previously suggested that strays are frequently due to extraterrestrial causes, perhaps being related to disturbances in the sun.



Consumption of potash salts in the United States for agricultural purposes



Consumption of potash for agricultural purposes in different countries



Comparison of amounts of actual potash used in agriculture and the industries

The Potash Famine

Its Magnitude and Effects, and Remedies Promised for the Future

By Thomas H Norton, Ph D, Sc D, Bureau of Foreign and Domestic Commerce, Washington

HOW many of us have come face to face with famine? Not many

Some years ago I followed in the wake of an Asiatic army Village after village of roofless, plundered homes and empty granaries separated by devastated fields and gardens The men were exterminated The terror stricken women and children would creep from their hiding places as I passed, fall at the feet of my horse, and beg for the fraction of a cent which might secure a meal

The hollow eyes and gaunt frames alone presented an appeal for succor, never to be forgotten

There are other famines besides those of human nutriment

This country is experiencing for the first time in its history a dyestuff famine Vast industrial interests, vitally dependent upon the factor of color, felt a condition of partial paralysis as months pass by without the needed supplies They suffer, exactly as a man would suffer, in whose diet the small but all essential constituent of mineral salts is systematically and continuously reduced to a fraction of what the human body requires.

Such a famine threatens American agriculture at the present time The plant life, to which millions of acres in our national domain are devoted demands its customary supplies of food Regular well balanced rations of albumen, fats, and carbohydrates, with small amounts of certain inorganic compounds are needed to maintain life in an animal organism In a similar manner, the crops of our farms, and gardens, and orchards require well-defined rations of combined nitrogen, phosphoric acid and potash, with slight amounts of various metallic compounds, in order to assure a normal, abundant harvest.

The phosphoric acid ration we supply easily from the inexhaustible deposits of phosphate rock and pebble in Florida, South Carolina, Tennessee and some of the Western States.

For nitrogen our fields depend chiefly upon the *sodium nitrate of Chile* and upon ammonium sulphate from Great Britain, along with a small amount of cyanamid and a larger amount of animal refuse, guano, etc Altogether we send annually, under normal conditions, about $80,700,000 abroad for combined nitrogen—$17,700 000 going to Chile The major portion of this Chile saltpeter is used, however, to produce the stock of nitric acid which we require in such abundance for a multitude of industries. A considerable amount of nitrogenous matter, for use as a fertilizer, comes from our slaughter houses, fish canneries, etc.

It is a matter of some concern that as a nation we are so dependent upon foreign sources for the greater portion of the nitrogen ration required in American agriculture, and for practically all of the nitric acid, indispensable in the manufacture of our high explosives.

In the case of potash the situation is much more serious We practically depend upon a single source—the mines of Stassfurt in Germany—for the entire quantity of potash compounds, needed by American farmers, and required in the arts.

What such dependence means has been revealed to us during the past year During the ten months ending October 31st, in 1913, we imported 811,000 short tons of potash compounds from Europe. During the same period in 1915, the imports were but 108,000

What is the effect of this shrinkage in the normal supply of potash compounds?

Ordinarily our broad acres expect to be fed with over 1,000,000 tons of potash salts each year They were on short rations last spring There was none for the autumnal culture There will be none next spring!

Our industries require annually over 23,000 tons of potash salts The magnificent glass industry, with its annual output worth over $90,000,000, consumes each year about 3,500 short tons of potassium carbonate

No supplies available for the glass blowers, nor for the manufacturers of gunpowder, nor for the soap boilers who specialize in soft soaps, nor for the makers of yellow prussiate or bichromate, nor for match manufacturers, nor for scores of varied industries preparing therapeutic, and photographic, and similar products in which potash is an absolutely essential component! The uses of the various salts of potassium, the chlorate, the bromide the cyanide, the iodide, the permanganate, and numerous others, are encountered in a large group of industries In all of these highly developed phases of human activity, the lack of potash compounds means as much of a dislocation as would the elimination of the butcher or baker from the life of a village People would not necessarily die, but it would involve endless readjustments to unexpected conditions.

The hardest blow falls after all upon the farmers of our country The effects will be felt most keenly in our Gulf and South Atlantic States, and in New England, where the use of potash fertilizers is highly developed

The following table gives an interesting glimpse of the extent to which this item of plant food is consumed in different states The figures represent the average number of pounds of pure potash (K_2O) employed per 100 acres of cultivated land

	Pounds.
Florida	2,131
South Carolina	1,817
New Jersey	1,307
Massachusetts	966
Maine	900
North Carolina	837
Rhode Island	810
Georgia	764
Connecticut	757
Delaware	747
Maryland	690
Alabama	517
Virginia	420
New York	307
New Hampshire.	288

It is astonishing to note how limited is the relative amount of potash consumed in the remaining states Thus

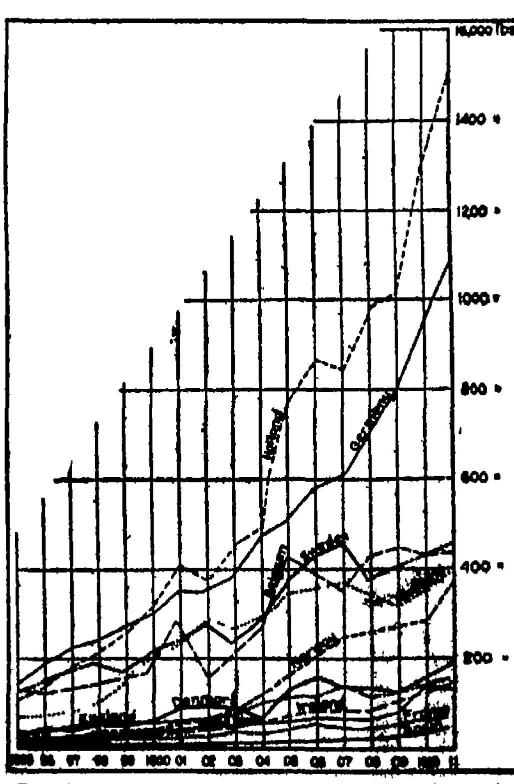
Illinois	12
Kansas	48
Iowa	23

I am tempted to wander from my main theme, and call attention to the fact that Germany, on an area, less than that of Texas, uses in her agriculture nearly twice as much potash as is consumed in the whole of the United States. Holland with an area equal to that of New Jersey and Connecticut, uses three times as much potash per acre, as these states, and a total amount equal to one seventh of our entire consumption.

Denmark is less than one quarter of the size of Illinois—a similar flat stretch of agricultural land. Yet it requires more than four times as much potash annually. Is it any wonder that the fields of those countries produce crops twice or thrice as large as the average yield of our own farms! American agriculture is still far from realizing how easily the harvests of its broad domain can be doubled, without an additional day of labor.

The question becomes acute with each passing day:

(Continued on page 162.)



Relative consumption of actual potash in fertilizers in different countries

New Developments in Military Aeroplanes

Aeroplane Destroyer versus Battle Aeroplane

By Ladislas d'Orcy

METHODS of aerial warfare have once more reached a new stage of development.

Five months ago the writer examined in these columns* the radical changes which had occurred both in the *matériel* and in the fighting methods of the air services of the warring nations, after one year of warfare. Under-powered machines had been weeded out, the monoplane seemed a craft of the past, the mounting of a machine gun had become generalized on scouts and on bombing aeroplanes; finally, the general trend of design seemed to lead toward the adoption of a high powered, large surfaced machine of great carrying power and heavy armament, which was termed a "battle-aeroplane."

This tendency was both noticeable in France and Germany, although the solution of the problem was carried out in ways fundamentally different.

The French conception was to provide an aeroplane with artillery superior in volume, but embodied into one gun, adequate armor protection and a fairly high speed. The result was the *avion-canon*, a 200-horse-power pusher biplane, which has a speed of about 80 miles per hour and mounts a 37 mill quick firing gun on the bow. The first flotilla of these aeroplanes was placed in commission last summer, and at once assigned to the defense of Paris. As soon as new flotillas came into being, they were sent to the bases behind the front and detached to escort the bombing squadrons on raids into enemy territory.

The action of the *avions-canon* was successful from the start, indeed, the protection they afforded to the bombing aeroplanes was so perfect that losses through German aircraft attacks had to be almost discounted, for even the most reckless bravery of a few German airmen could not compensate their inferiority in armament.

At about the same time there appeared over the Western lines the German version of the battle-aeroplane. This was a twin tractor Albatross biplane, whose two 165-horse-power Mercédès engines could furnish a top speed of well above 90 miles per hour. The armament consisted of two Maxim guns, mounted one fore and one aft on a central nacelle, the pilot sat between the gunners. The normal radius of action amounted to 8 hours' navigation, but if the fuel supply was reduced so as to last only for 6¼ hours, 12 bombs, each weighing 10 kgs., could be added to the armament.

On a more advanced model of this machine the power plant consisted of two 225-horse-power Mercédès engines, the nacelle was armor plated, and a third Maxim (or, according to some reports, a small cannon firing grape shot) was added to the battery.

The appearance of this battle aeroplane was marked by an unprecedented execution among the aeroplanes of the Allies, for while the latter possessed a number of machines that were just fast enough to catch up with the dreaded "Arminius" (as the French nicknamed the "Teuton"), none of them carried more armament than one machine gun. As to the *avion-canon*, it had not sufficient speed to bring into play its powerful cannon, and "Arminius" was always clever enough to decline a fight with the French battle-aeroplanes.

Fortunately for the Allies, French ingenuity soon found a remedy for this terror of the skies. A special type of aeroplane-destroyer *avion de chasse* was at once commissioned by the French. This machine was nothing but the racing monoplane the Morane-Saulnier firm had built in 1914 for the Gordon Bennett Cup. In the hands of all but an expert pilot this monoplane would have been of little use in warfare, but it was Gilbert, the celebrated airman, who led the first Morane against "Arminius" and the battle ended with the victory of the Frenchman, for the "Teuton" was set on fire.

Copyright, International Film Service

Nacelle and quick-firing gun of a French avion-canon

A retrospective review of this battle shows that a powerful aeroplane carrying a battery of two or possibly three Maxims and a crew of three or four (it fell inside the German lines, which precluded its inspection), was put out of action by a one-man machine, being 10 miles faster than its opponent, and in which the pilot acted as gunner. For the armament of the Morane destroyer consists of a machine gun built into the fuselage just in front of the pilot, which gun is aimed by steering the whole aeroplane against the target. The machine being a tractor, it is self-evident that the gun fires through the air screw, but in order not to injure it, the latter is protected by armor plating which deflects the bullets that may hit the blades. In this manner only about 30 per cent of the bullets are lost.

After Gilbert's feat had been repeated by two or three other pilots with equal success, "Arminius"—which was incidentally responsible for poor Pégoud's death—suddenly disappeared from the western front, all the machines of this type were then sent to the East to participate in the big Teuton drive against Russia, where aerial laurels seemed easier.

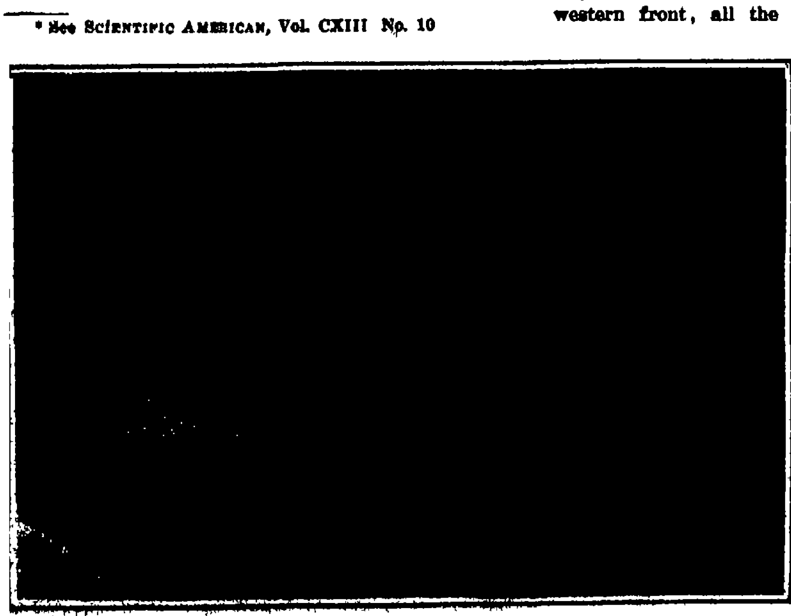
Nevertheless, the Germans were far from being discouraged that "Arminius" had not proven unbeatable, for soon afterward another type of German battle aeroplane loomed up above the lines in France and Flanders. This was a single tractor biplane of the Albatros and the Aviatik makes, and was fitted with either a 180-horse-power Maybach or a 225-horse-power Mercédès engine furnishing a speed well near 90 miles per hour. While slightly slower than "Arminius," "Fritz," as the British called it, had a range of 10 hours flight, it carried in addition to ten 5 kgs. bombs, two Maxim guns, one in front, mounted above the engine but firing sideways only, and one behind the pilot. Being sufficiently fast and responding much quicker to the controls than "Arminius" this machine maneuvered in such way as to range up alongside its opponent and discharge a broadside from both Maxims at once.

While in no way a match for the *avion-canon*, Fritz was undoubtedly superior to any one-machine-gun craft of the Allies, with the possible exception of the Morane destroyers, but of the latter only a limited number were available on account of the exceptional skill required for flying them. But it seems that the French had foreseen this contingency, too, and before Fritz could do much harm among the Allies, it was met and defeated by the speedy Nieuport tractor biplane.

There was nothing extraordinary in the latter machine, it was very fast, a good climber, very manageable, and of quick responsiveness, in general appearance it followed the orthodox lines of the well known British "tabloids," such as the Sopwith, the Bristol, etc. But what inaugurated a new era in aerial fighting was its gun emplacement. Instead of mounting a Hotchkiss on the fuselage either firing through the air screw or backward and sideways, the Nieuport destroyer has its machine gun mounted on the top plane and the gunner operates it standing. This arrangement enables the pilot to attack an enemy from below before the latter is able to bring into play, after the necessary maneuver (bank, turn, or dip), its own battery. This novel system of gun mounting cost the Germans a goodly number of machines, and eventually they adopted it themselves, with one variance, however, in that they added to the armament an automatic rifle that could fire backward. The mounting of the latter weapon is very ingenious, it is rigidly fixed to a pivoted seat, which can rotate in an arc of 180 deg., so that whichever side the gunner turns to the rifle always remains in front of him, ready for action. Such is the armament of the 165-horse-power Mercédès Aviatik tractor biplane, which can be considered to represent, at the moment of writing, the latest all round type of the German aeroplane destroyer.

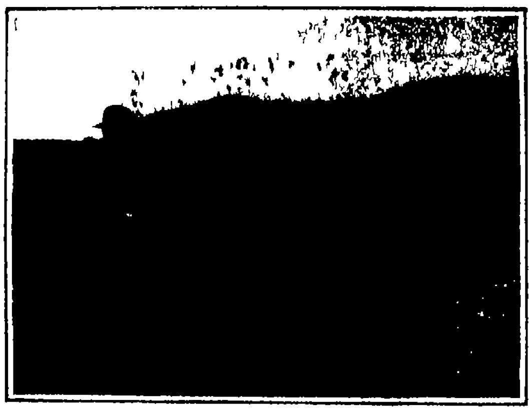
(Concluded on page 164)

* See SCIENTIFIC AMERICAN, Vol. CXIII No. 10



Védrines in his Morane single-seater monoplane getting his machine gun ready for an aerial combat

Védrines examining the automatic rifle of a German Mercédès-Aviatik tractor aeroplane which he captured single-handed



'Guard," opening of all bayonet attack

The thrust and parry

The lunge and parry

Bayonet Fighting

An Ancient But Indispensable Form of Combat

By Edward C Crossman

ON the face of it the most ridiculous phase of modern fighting is the fact of the efficiency of a sharp knife stuck on the end of a clip-loading flat trajectory magazine rifle

The contrast between the two weapons, the sharp knife and the rifle, is the contrast of 2,000 years By itself the knife is not so efficient as the short sword of the legions of Cæsar On the empty rifle the knife is not so efficient as the spears of the Macedonian phalanx

Despite this queer mixture of the weapons of the pre-Christian era and the highest development of modern ballistics, there is good reason to believe that the bayonet is not only not doomed, but is to have still more attention paid to it after the present war

It was logical enough in the days of the muzzle-loading rifle with the delay of a half minute or so from shot to shot, and the ridiculously close range at which our forefathers fought. It was logical enough when the rifles and muskets of those times would hardly hit a barrel at 100 yards, and would miss an ice-house at 400 yards It was logical enough when the fashion of fighting sent cavalry galloping past the front of massed infantry until the fire of the footmen was drawn and the horsemen could smash and hew their way down through the close-packed ranks of men with empty rifles. Always horses disliked bayonets. When the infantry rally early enough to let the horses get a good view of the bristling, gleaming hedge that stands round each square, the steeds turn at the last moment and refuse to immolate themselves at the behest of their riders. Then the only recourse of the peeved cavalrymen is to lean far over and slash at the infantry with the long sabres given them for that especial purpose

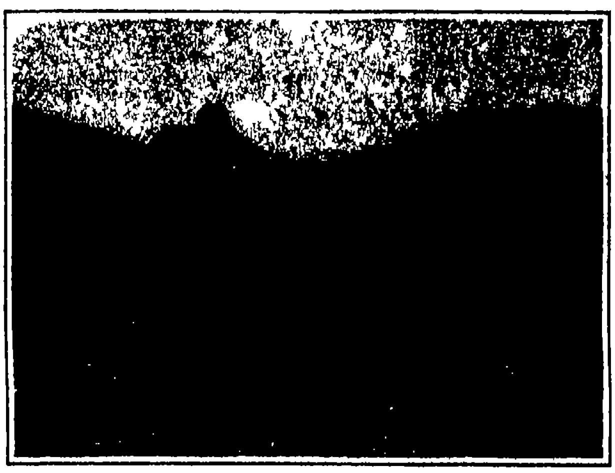
But those days are gone Cavalry rarely charges in the face of magazine clip-loading rifles If it becomes thus incautious it merely helps to send up the prices of American horses. The normal infantry combat outside of entrenched positions, opens at 1,200 yards. The modern infantry rifle speaks thirty to thirty five times a minute It can be recharged with a fresh clip in 4 seconds from the last shot of one clip to the first shot of the other It shoots into a circle the size of a barrel head at 1,000 yards instead of at 75 yards No smoke conceals the movements of the other force, bullets fly fast and flat, and do not miss because of slight errors in sighting setting

With all this true, the use of a sharpened knife 18 inches long on the end of such a magnificent weapon as the modern rifle, would seem the act of a child or a madman

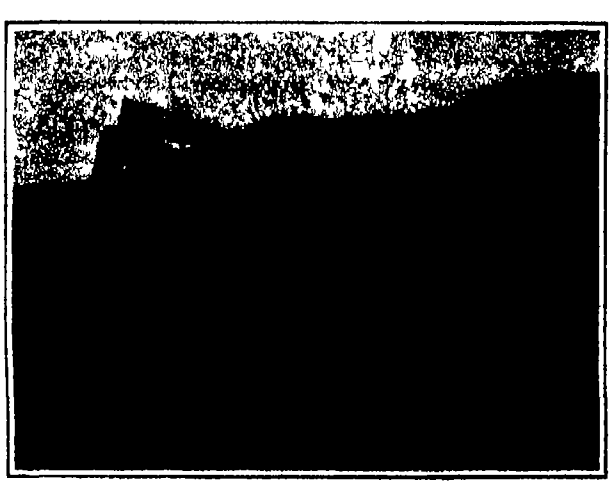
But, not only has the sharp knife proved its usefulness in the close fighting between trenches where one might expect sharp steel to prove useful, but it has helped Germans to drive Russians out of the most temporary positions where the fight started at long range, and it has in turn induced the Teuton to turn his back hurriedly on Petrograd and to commence an accelerated progress toward Berlin

Up to the time of the Russo-Japanese war the bayonet had gradually fallen into disgrace The experience of the British in the Boer war, in 1900, when the Boers had no bayonets, and the British found that the Boers had merely decamped, when they got close enough to the Boer positions to use their own, seemed to prove that the long knife was about as useful a part of infantry equipment as a pair of brass knuckles would be.

In 1903, between the Boer and the Japanese wars, the United States got out a new rifle, a modified Mauser, clip-loading and of the most modern type. On this rifle, the new Springfield, our ordnance people put a compromise the smallest bodkin that ever rifle wore It was a rod bayonet that normally rested in the stock below the barrel like the old style ramrod It extended about a foot beyond the rifle muzzle when in place for service was about the size of a pencil, and had a sort of a point—that is a heavy enough lunge of the rifle would probably have inserted it into the anatomy of an enemy



A low thrust and parry



Head cut and parry

The Japanese and Russians upset all the traditions of three years' standing, established by the Boer war Probably a poorer exhibition of rifle shooting never was given than that put up by the Russians and Japanese, but they made up for their deficiencies by savage attacks with the bayonet in the face of all the machine guns and high explosives and magazine rifles that modern science had conjured up

Immediately the United States shucked one-rod bayonet off its new rifle, and installed a formidable sword bayonet, carried normally in a scabbard like the bayonets of other powers, extending 16 inches beyond the muzzle of the rifle, double edged at the point, and sharp all the way down one edge.

Detached from the rifle and gripped by its very efficient handle, it makes no despicable weapon, it can be used to dig hasty and temporary shelters, and it can be slipped on the rifle in an instant. Of course, like all other bayonets, it does not interfere in the least with firing the rifle while it is in place on the muzzle.

The Russians have made more use of the bayonet than any other nation now at war, a natural result of poor riflemen and a superabundance of soldiers, and a more or less half civilized people who naturally trend like all half civilized people, to the use of cold steel

The Russian bayonet is never detached from the rifle, and no scabbard is provided for it. It is quadrangular in cross section, with the point chisel shape, and it is 16 inches long The blade is set at a slight angle to the barrel, the point higher than the muzzle Queerly enough the blade is browned or "blued" like the barrel of the rifle, aiding to protect it from the elements, but taking away from the effect of the bristling line of shining steel that the perturbed foe normally sees when attacked by the bayonet. The scare is half the effect in a bayonet charge, often the opposing troops do not wait to argue out the matter

The few reports we get of the savage fighting of the Balkan wars of 1912, agree that the Bulgarians took to the bayonet at the slightest provocation, and that the Turks hastily left at the first sight of the long line of bright steel that suddenly appeared One instance is given of the attack of a whole brigade with the bayonet that began at 400 yards. That is, the Bulgarians fixed bayonet and charged the Turks at a distance of four city blocks from the Turkish position Unless supported by the most fiendish smothering artillery fire, the Bulgarians would have been wiped out by expert riflemen manning the Turkish position, but expert riflemen were scarce. At Kirk Kilisseh several brigades of Turkish recruits were pushed into the fight, so raw that they had been instructed but the night before how to load and fire their rifles

Possibly the wooden bullets that the Bulgarians found in some of the Turkish cartridges at Kumonavo helped to weaken the Turks' usual courage.

The present war has gone far to prove the old claim of the infantryman, that infantry is queen of battles You can pester the foe and learn of his movements with your cavalry, and you can pound his trenches to bits with your artillery, but you cannot take and hold his position without the infantry Apparently we are to add to this the proviso that you cannot do this without the infantryman's bayonet.

The British are paying much attention to the bayonet in training their troops. Part of the training game is to rush an "enemy" trench, leap it, and plunge the bayonet into sacks on the other side representing the foe. Another phase is rushing man-size figures hanging by ropes and lunging the bayonet through them without halting the rush.

Of course, this is the field training. As preliminary training the recruits are carefully trained in attack and defense with the bayonet, just as men are taught to box. Giving no other odds to either side, the trained man can simply murder an untrained opponent.

In the American army, bayonet exercises are part of the course, and bayonet fighting with dummy rifles and blunted, light, springy rods for bayonets is well worth seeing.

Although the lunge of a bayonet-fitted rifle in the hands of a powerful man is amply sufficient to drive the blade through the ordinary door, the course of the blade is easily turned just as is the blade of the fencer's foil. A single lunge parried, and a quick lunge in return settles the contest between the untrained and the trained man. There is more difference here than there is between the boxer and the novice, because the latter

if he is strong, can always close and go to wrestling, while dealing with a man at the other end of a bayonet-fitted rifle, is not so easy.

The sword bayonet is both a thrusting and a cutting weapon. Naturally the thrusting part of the programme is the fatal part, yet a cut of a sharpened bayonet may weaken or demoralize an opponent until he gives ground or falls victim to the lunge.

In the American army the soldier in bayonet fighting is taught to grip the rifle at the small of the stock or grip with the right hand, and the portion just ahead of the rear sight with the left hand, bolt handle upward, barrel toward the body, bayonet at the height of the chin, left foot extended, body balanced on the feet like that of a boxer on guard.

In our service there are only three attacks with the bayonet, but, strangely enough, the butt of the rifle is also utilized as an offensive measure, and this is part of the bayonet training.

In the three-bayonet attacks, the thrust is merely a quick drive forward of the rifle, without moving the feet, the butt at the height of the chin, the barrel to the left, the rifle lying on its side. The lunge is the same motion, a slight lifting of the rifle and a drive forward almost horizontally, but here the soldier advances the left foot as he lunges, thus throwing his weight behind the drive.

These two thrusting attacks are supplemented by the right and left cuts, the left cut, for example, done by slightly drawing the point of the bayonet to the right, then making a slash to the left by quickly extending the arms. The right is the reverse. With the ordinary half sharp blade this attack is of little importance, but with a sharp bayonet, whetted to a razor edge as the Bulgarians carried theirs, an attack of this sort, ending in a slash across the opponent's arms or hands, might speedily disable him.

The attack with the butt of the rifle, which is merely driven to the front, to the rear by a pivot of the body, or to the left or right, is useful chiefly for rioting, where the bayonet would not be used, or where close quarters did not allow the blade end of the gun to be brought into action.

The defense against these attacks are merely two sets of parries, the right and left, and the right low and left low. In the two, first mentioned, the parries are nothing more than short quick motions of the left or controlling arm, moving the bayonet point 6 inches or so the right or left of normal, and so catching the blade of the opponent's rifle. As the rifle on the defense is held firmly between the two hands, with the arms close in and the gun under full control, it is easy to turn off the blade of the enemy rifle which is of course extended at the length of his arms and easily deflected by the firm opposing blade.

The danger to the tyro is that in parrying he may move his bayonet too far in his anxiety to get the threatening blade as far to one side as possible, lose his chance for a return thrust, and open himself to the real thrust of which the first was only a feint.

The combination of these simple movements makes a dazzling attack and defense in the practice bayonet fighting in the regular service. Anyone who has ever watched these contests between practiced bayonetmen will agree that, as stated, a fight between the trained bayonet fighter and the untrained man, is merely slaughter.

In the breasts of many people cold steel arouses a thrill of horror, not inspired by the knowledge of the power and "undodgeability" of a bullet. Doubtless this is why so many positions are evacuated on a bayonet attack without waiting for the final argument.

On the other hand, the bayonet is dangerous just so long as the arms and the rifle will reach, and the danger is always in sight and always avoidable by giving ground or superior skill with the same weapon. The bullet is dangerous, clear to the horizon, cannot be dodged, carries no if's and and's as to penetration, and all in all, knowing both bayonet and bullet as well as I do so far as peace experience will let me, I would prefer the bayonet to one shot from the rifle.

The Current Supplement

THE leading article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No 2092, for February 5th, on *The Structure of the Atom* covers a problem that lies not only at the foundation of chemistry, but of electricity and, in fact of all physical science. The present article is of unusual importance and is by one of the greatest authorities on the subject. A short illustrated article on *Grenades, Rifle and Hand*, gives an excellent idea of the construction of some of the smaller projectiles now being used in the European war, and how they are used. A somewhat similar article on *Throwing Bombs from Airships* describes how these explosive shells are dropped from a fast moving air craft so as to hit a desired object on the ground. *Some Notes on Optical Glass* outlines the processes of manufacture and explains the nature of various imperfections and the means of obviating them. *The Region of Greatest Snowfall* tells of a startling extreme exhibited by the climate of California, and there are a number of unusually interesting photographs to illustrate the subject. The important article on *Our Merchant Marine* is concluded, as well as the article on *Oil Mixed Portland Cement Concrete*. *The Alternating Current Single Phase Induction Motor* is a simple explanation of how this machine runs and why it runs. This will be welcomed by many readers who hesitate to attempt an intepretation of the intricate mathematical explanations usually given. Among the shorter articles of interest is *A Mechanism of Protection Against Bacterial Infection*, and *The Consumption of Shells*, that gives some facts relating to the number of projectiles being used in the war, and their production.

Bayonet mounted on an old-time rifle

A bayonet fixed in position does not interfere with the firing of a rifle

On an old-time military rifle of this type, the bayonet was indispensable

Standard attachment of sword bayonet

Ring in belt of bayonet slips over muzzle at *A*. Dovetail slot with spring stud engages stud at *B*

The Campaign Against Cancer in New England

THE New England States generally show a higher death rate from cancer than any other group of States. This does not mean that New England people are more susceptible to this disease. Cancer is a disease of later adult life, and it is well known that in parts of New England there are more old people proportionately to the population than in many other regions. Nevertheless, the death rates recently published by the U S. Census Bureau have stimulated much activity in these States in the educational campaign for the immediate control of malignant disease.

What are the facts upon which this movement is based? According to the report of the Census Bureau, in 1913 there were 49,928 deaths from cancer in the registration area of the United States, corresponding to a death rate of 78.9 per 100,000 of the population. All the New England States have individual cancer death rates much higher than this. Connecticut's rate, which was the lowest of any of the New England States, was 85.1. Vermont's rate was the highest with 111.7, while the rates of the other States were correspondingly high, Maine having a rate of 107.5, New Hampshire 104.4, Massachusetts 101.4, and Rhode Island 93.3. When these figures are compared with those of Kentucky with a rate of 48 they seem indeed very high. They mean that 6,817 people died in 1913 in New England from cancer. But it does not necessarily follow that cancer is more common in New England than elsewhere. The Census Bureau attributes the high cancer death rates in certain districts to the relatively high age distribution of the population and the negligible amount of immigration. Translated into everyday terms this means that in New England the proportion of people over forty years of age, or at the cancer age, to those under forty, and so less liable to cancer, is greater than in other places. Yet there is no doubt that the cancer death rate in New England as well as in other parts of the country, is much higher than it ought to be. Without question a large percentage of cancer deaths can be prevented by early recognition of the symptoms and prompt recourse to competent surgical advice and treatment. Cancer is not a hopeless incurable affection, as so many people wrongly believe. Those who know the facts believe that if the public can be properly educated in regard to the early signs of the disease and will act on this knowledge, the present mortality should be reduced at least half and perhaps two thirds.

That New England is awake to this opportunity of saving lives is evident from the activity in several States. To protest against taxation without representation the patriots of Massachusetts dumped overboard the famous cargo of tea. Vermont medical men have become so concerned over the high cancer death rate of their state that they are going to hold a "tea party" of another sort and attempt to dump overboard the high death rate from malignant disease. While their action is not so dramatic as that of the patriot raiders they hope to prove that through its great ultimate benefit to the community it will be almost as patriotic. The New Hampshire State Board of Health has recently published sound advice in its *Bulletin*. In Maine an active committee of the State Medical Society is arranging public lectures and causing the publication of instructive articles in the newspapers. Massachusetts has a well organized branch of the American Society for the Control of Cancer with headquarters in Boston. The Vermont State Medical Society has arranged a series of public meetings to spread the bad news of the high cancer death rate and the good news of the hope of controlling the disease by earlier recognition and prompt surgical treatment. Morning afternoon and evening meetings will be held on Tuesday, Wednesday, Thursday and Friday, June 8th to 11th at Rutland, Burlington, Montpelier and St Johnsbury. The Vermont State Board of Health will send its secretary Dr Charles F Dalton, to address each of these meetings, and the American Society for the Control of Cancer will be represented by Dr Francis Carter Wood and Dr J M Wainwright.

Strategic Moves of the War, January 27th, 1916

By Our Military Expert

IT would be rather presumptuous, owing to the paucity of information from various theatres of war, to say whether certain military operations were of the nature of major movements or only incidentals, for apparently insignificant conditions may contribute decisively to victory or defeat. The mere destruction of a bridge, thereby delaying the arrival of reinforcements at a critical time has ere this affected the outcome of wars For this reason, while one is apt to dismiss the operations in Armenia and Mesopotamia carelessly, almost as though taking place in another planet, they may, in some way now unknown become of vital importance—possibly through the necessity arising for the dispatch to this section of heavy Turkish forces at the expense of another

The Erzerum section is very remote for purposes of Turkish reinforcement. There are no railways leading into this theatre, the roads are not of the best, the country is broken and forbidding and the distance from central garrison points is almost prohibitive

The use of the Black Sea as an avenue for the passage of Turkish forces is beset with menace Russia has her Black Sea fleet principally employed in watching the coast line and the armada which would sail for Trebizond from a Turkish point, would be rash in deed—foolhardy would be a far better word

The Russian operations in the Caucasus have extended from the sea to the shores of Lake Van, the large body of water about 200 miles southeast of Erzerum The battle line is not continuous, of course, for geographic features permit the employment of detachments of greater or less size, only nominally in contact with lateral forces

Latest dispatches indicate a material Russian success in the center, directly before Erzerum, recounting the virtual rout of three Turkish corps backed up by the Erzerum garrison afield

The campaign began effectively in the early autumn and almost immediately resulted in local successes along the seacoast near Olti, and in the Lake Van region The Russian flanks were secured, defeat of the Teutonic forces near Urumiah contributing materially

The massed Russian movement against the center commenced in December, during which the Turkish army attempted to double up the flank near the sea, but without avail As a result of the failure and the breaking of the center, general retreat toward Erzerum became necessary Apparently the Russian forces were sufficiently in hand to undertake pursuit for according to reports, the retirement still continues

Erzerum lies in the province of the same name in Armenia and is about 110 miles southeast of Trebizond, a Black Sea port. About the same distance to the northeast of Erzerum lies Kars a railhead which must be the main Russian base Slightly to the westward, the Kara, or Western Euphrates river winds to the southwest, being joined by many confluents.

To the south of Armenia is Kurdistan, a territory equally rough, equally difficult. It is over this terrain that any further material Russian advance must be made should conditions permit the thrust

About a hundred miles southwest of Erzerum is the city of Erzingan on the Western Euphrates While of little material importance commercially a number of practicable roadways center here making it a probable point of objective in the future The Euphrates is considerably more of a stream at this point than at Erzerum, and is an available means of supplying a further advance

South of Erzingan and southwest of Erzerum is Kharput, another road junction of importance Owing to the mountain ranges which almost seem to interlace, an advance upon Arghana, which is about thirty five miles southeast of Kharput, must first pass in the vicinity of the latter place before swinging to the southeast.

Arghana is near the source of the Shat, the Western Tigris, along whose banks at Kut-el Amarah about 450 miles to the southward, British forces are striving to hold on in the face of superior strength until the British relief expedition can carve a way to the rescue—if it ever does. But the Eastern Euphrates is north of Arghana, running almost east and west, and constitutes a natural line of defense which must be forced before the Tigris can be reached

It is therefore evident that if the objective of the Russian movement in the section is to combine with the British allies, the Tigris must be gained—and it is a long, hard passage which confronts the undertaking The existing problems of supply and transportation belong to a past era of military operations, when commanders had not learned to lean heavily upon a network of railways to supply their many wants and which permit the prompt shifting of troops from point to point, the situation calls for the resourceful genius of a Bonaparte or a Stonewall Jackson, both of whom seemed to find their greatest measures of success under similar circumstances, when mountain barriers were utilized for concealment of movement, division of forces and defeat of an enemy in detail

The recent observation of a British officer that strategy is a lost art, remains to be proven or corroborated, for the operations in the Caucasus call for —and will continue to call for—exercise of this art to an nth power

According to Constantinople admissions, the Russian force in the Caucasus section is superior to Turkish Under the advantage of the defensive to-day, owing to modern armament which provides a much heavier volume of fire and a far greater range than formerly and in view of the character of the theater of war, tremendous losses must be sustained in any direct attack against fatalist forces which are apt to stand to the last and fight it out breast to breast. On the other hand the railway base advantage lies with the Russians for Kars is nearer the front than any Turkish resource can supply and the feeding in of reinforcements and materials should be easier

When the Dardanelles campaign was abandoned by the Entente, it is reported that a considerable number

Russian operations in Turkey

of Turkish troops and some German forces were dispatched to the Caucasus front without delay The distance is great and almost the entire journey must be made by marching with accompanying difficulties of supply The weather is now bitterly cold for such a venture and the resource of the country does not lend itself to any great extent to sustenance

As a corollary, it will take just as long to shift these forces back to Turkey proper, or to the Balkans, should the situation demand it

The section of the Russian general advance is reasonably well secured The right is covered by the sea coast—and is further secured by the Russian fleet which blocks the landing of an attacking force in the vicinity Northwest of Erzerum, mountain chains interpose between the Black Sea and the valley of the Western Euphrates, while other range-spurs and lesser chains are freely scattered east, west, south and north The entire country is alternately mountain and valley, with here and there moderate plateaux, until Kurdistan and the lower Tigris are cleared

To the eastward, Lake Van establishes a splendid pivotal point, easily defended and secure from molestation. Hordes of Cossacks are reported to be operating in the vicinity of Van, not only in reconnoissance and screening but in good, old time shock action which carries one back to the days of the Empire.

That the Russian offensive is deliberately aimed at a junction with the British movement from the south, is to be doubted Certainly the English forces on the ground are insufficient to lend much probability of success to maintaining their end of the bargain. It would appear to constitute much more of a direct thrust at the Turkish interior, to the detriment of supplies, availability of men, isolation of part of the territory of the Ottoman and moral effect The very strength of the operation suggests the reflection that Russia must have a greater number of men available for use on lines of battle than can be used on her main line against Germany and Austria and that the question of arming, equipping and supplying her forces has been reasonably solved, for necessarily the extension of her battle lines would never be undertaken by a country in desperate straits—on the contrary, under such conditions the lines would be restricted as much as possible, to make for concentration.

The military resources of the Turkish Empire are not great. With a population of twenty million people, in both European and Asiatic Turkey, an eight per cent basis of estimate for available man power results in 1,600,000 bayonets But it is hardly reasonable that this number is available, on account of the non-existence of railways to bind the sections of the empire together If, then, Turkey has a million men in the field, it is the result of German insistence, organization and assistance

Of this number, there are possibly a hundred thousand engaged in the threat against Saloniki, a hundred thousand in the vicinity of Constantinople, a hundred thousand along the lower Tigris, three hundred thousand scattered along the Caucasus line and immediately in reserve A general remainder of four hundred thousand should be necessary for garrisons elsewhere, internal police, recruiting and supply and general reserve

On the other hand Russia's population of 165,000,000, on an 8 per cent basis gives 13,200,000 men available for military use This staggering force cannot possibly be equipped or actually in use at the present time, eight million is considered an over-liberal estimate. Probably from three to four million Russians occupy the main line, from Bessarabia to Riga, including the forces held in local reserve and on the battle-front communications Another two millions should be engaged in general reserve, supply and police in the interior, from the remainder not accounted for, a force varying from half a million to a million men should be available for use in the Caucasus and it is believed that developments will indicate the local strength as lying between these figures It is certain that as things now are, Russia should have preponderant strength in Armenia, it remains to be seen whether it is ample to create an acceptable diversion or secure a material victory to the Entente cause

Horse Manure Kills Flies

ON the battlefield M Roubaud observed that horse manure was in the first place a propagating place for flies which are so thick in some of the trenches, but as he states in a note presented to the Académie des Sciences, this may, in turn, act to kill the flies, or rather the larvæ. In fact, the fly lays her eggs in fresh manure, but when it is several days old she no longer does so, for this ferments very rapidly and the temperature rises to 60 or 70 deg C Such an elevation of temperature is fatal to the larvæ, and they are killed within 3 minutes at 50 deg and in 4 or 5 seconds if at 60 deg Hence it results that the best way to kill the flies is to bury the fresh manure with its larvæ, inside the pile, and if this is done, 90 per cent of the larvæ will be killed This is an appreciable result when it is noted that a cubic yard of material can contain 35,000 eggs.

Ball Extracted from the Heart

DR. INFROIT made a communication of a remarkable character to the Académie de Médecine, concerning the extraction of a shrapnel ball lodged in the heart of a wounded man, in the right auricle. This operation shows the great progress which is being made in localizing objects by means of radiology, and Dr Infroit makes use of the new "radiological compass" invented by him Owing to the great precision of this apparatus, he is able to extract foreign bodies of all kinds, such as uniform buttons, plates or badges, coins or various projectiles lodged in the lungs, brain, liver, and other organs of the body One of his recent operations was the extraction of a large coin (5-franc piece) from the abdomen Owing to the great exactness of the localization, the organs are not injured during such very delicate operations.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Problem of the National Guard

To the Editor of the SCIENTIFIC AMERICAN

In your January 8th issue, "Patriot" answers my article published in your November 27th issue, and, because he has made some mis-statements therein, I am constrained to ask you to print the following

He says that because the labor union men are opposed to the militia, or the guard, on account of its service in times of strikes and riots that the regular army alone should be assigned this duty thus enrolling the labor union men in the militia This course would, no doubt, increase the militia greatly But, assuming his proposal be adopted, can he not see that it would be only a question of time until the labor unions would oppose the regular army for the same reasons they oppose the guard now? Can he not see that this would create a serious obstacle in the path of adequate preparedness? He says that it would be very foolish to put other than the best man on the job Will he consider thoughtfully the seriousness of, and the foolishness of, our regular army contending with unorganized bands of militia?

In his second paragraph he intimates that the guard is lacking in brawn I, of course, have no facts to refute it, but I will ask him to note carefully during his next tour of duty whether the laboring man possesses all the brawn

His high minded citizen does not cast a slur on the guard on general principles His high minded citizen supports the guard in the State of Texas where support is eminently needed The slur to which he probably refers is paragraph 8 If "Patriot" will do me the justice to re-read my article he will surely retract his statement, for I very carefully qualified the first sentence with the words, "compared to a genuine military force", and surely for militia to be exempt from militia duty would be omitting its cardinal duty I haven't the slightest doubt that practically all the officers and men in the guard are there for war only, not strike duty but what is to be done?

"Patriot's" fourth paragraph He should know that the dual command of the guard is one of the serious faults of the establishment He should know that it is only after the President proclaims a state of war or imminent danger thereof exists, or there is rebellion against the constituted authority of the United States, that he can call the militia into the service of the United States and send them any place within the continental limits of the United States Who was in command of the Texas guard when the Governor of the State ordered a regiment of infantry, two troops of cavalry a battery of field artillery and a hospital detachment to the Mexican Border in April, 1914, at the very evident displeasure of the President? Who was in command of the South Carolina guard when the Governor of that State recently disbanded the entire organization? Who will be in command the day war breaks and what will happen? I am familiar with the control the Division of Militia Affairs exercises over the guard, but that is not "supreme command" It should be of course, in time of peace, because it is planned to be in time of war He has no doubt that the present Congress will make the limits where the guard may be sent any place under the flag A study of the constitutional difficulties will dissipate this expectation Even if it were thus I fail to understand the military strategy of planning our next campaigns on our own precious soil

In his next paragraph he says, "Likewise the statement is wrong that the last Congress made provision for enlistment in the regular army for a term of eight months." This statement makes my reply necessary Will he please read again my article and acknowledge his mistake? I thought that a national guardsman would immediately recognize the new volunteer bill when I mentioned the transferring into the volunteers, but he does not seem to be familiar with it If he will refer to War Department Bulletin No 17, May 1st 1914, he will find what is referred to in my first paragraph, and if he will read my second paragraph, he will find that the eight months have no connection whatever with the volunteer bill mentioned.

Instead of exempting the guard from riot duty on a false theory of right and wrong, what is needed is universal compulsory service in the guard, the appointment of its officers by the President, the supreme command vested in the President, the provision of suitable authority for the Governors in times of riot, and the perfection of the plan, by making all necessary preparations, to transfer in time of war national guard organizations into the volunteers.

I concur in the belief that eight months is not long enough to make a soldier It is too bad that all patriots and citizens do not believe it. It was only suggested.

In conclusion I take the liberty of using "Patriot's" concluding paragraph, substituting for the second word, "allowed," compelled.

CITIZEN

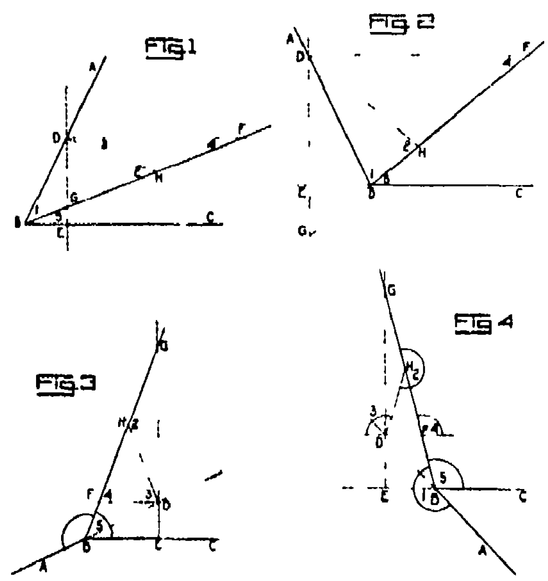
Trisecting an Angle with a Ruler

To the Editor of the SCIENTIFIC AMERICAN

I was much interested in the method of trisecting an angle as given on page 271 of your last volume The conchoid curve and the machine for drawing it are unnecessary, however and the same accuracy may be obtained with a ruler and dividers. Moreover the following method, though based on the same principle as that given, is not confined to the trisection of acute angles, but applies equally well to the trisection of obtuse and reflex angles.

To trisect the angle ABC

From D on the line AB (or AB prolonged) draw DE perpendicular to BC (or BC prolonged) and draw DF perpendicular to DE. Locate the perpendiculars so that DF, if prolonged, will cut the bisector of the angle ABC inside the angle Figures 1 to 4 show an acute angle, an obtuse angle and two types of reflex angles and the treatment of each On a ruler or straight edge lay off



Method of trisecting angles

a distance FG equal to twice DB Now adjust the ruler so as to bring the point F on the line DF and the point G on the line DE while the edge of the ruler passes through B Draw BF The angle FBC is one third the angle ABC

Though the details differ in each figure the proof may be outlined as follows for them all

To prove angle ABF equals two times angle FBC

Draw DH bisecting FG at H By construction and plane geometry BD = DH = HF = HG forming the equal sides of several isosceles triangles.

$$\begin{aligned} <1 &= <2 \\ &= <3 + <4 \\ &= 2 \times <4 \\ &= 2 \times <5 \\ <ABF &= 2 \times <FBC \end{aligned}$$

Has anyone a method for dividing an angle into five seven or eleven equal parts?

WM S CHAPIN

Vanderbilt Mich

The Wireless Amateur and Preparedness

To the Editor of the SCIENTIFIC AMERICAN

Heretofore the activities of the "Amateur" wireless man have attracted little attention from the public, and at times even been viewed with more or less disfavor by the Government, but since the question of preparedness has come into such prominence it has been discovered that the United States has in its amateur wireless operators a military asset of prime importance, and this for reasons so plain that anyone can understand them

Everyone knows that a certain proportion of trained wireless men forms an indispensable part of every modern army and navy, and everyone who has given the subject any thought, must also realize that the great reserve force now contemplated by our country would require the services of operators by thousands. The ordinary telegrapher is not a radio operator, and could not become such without months of training The commercial wireless service could not be drawn upon for its numbers are not sufficient and it is even in time of peace short of men. Where then would the Government get its radio operators in case of war? There is only one possible answer—from the ranks of the amateurs.

As to the number of men that would be required it may be noted that since the war began, the British navy alone has required the services of 5,250 radio operators!

Thanks to a liberal and characteristically American Government policy, we are fairly well off in this regard, the latest list of radio stations showing that we have 5,073 stations of which 3,836 were licensed amateur stations, the balance being Government, commercial, and ship stations Of course some of the amateurs are mere beginners but a large number have become first-class operators and having worked from the bottom up, without much encouragement, even making their own apparatus and overcoming each obstacle as it appeared, they possess a more thorough understanding of the art than can be had in any other way

Besides enlisting in the army there are several other ways in which the amateur radio men would be of service to the country in the event of war Our country is so vast in extent that it would be impossible for the Government to maintain a sufficient number of stations to listen for enemy or spy stations in our own territory, but the amateur stations are everywhere, and it would only be necessary for the Government to pass out the word to listen, and it would at once become impossible for any spy station to work without being discovered

The foregoing facts should be considered by every one interested in preparedness and the Government induced to give the "amateur" every encouragement

J V PURSSELL

Washington, D C

Does the Ether Revolve?

To the Editor of the SCIENTIFIC AMERICAN

On reading your answer to D S C 14010 in the January 15th issue, Department of Notes and Queries, it occurs to me to suggest that since the sun is rotating and since every tangible object in this universe is revolving around the sun is it not a reasonable supposition that the ether within this solar system is likewise in movement, *rotating with the sun as a center*

Taking this hypothesis, even were the ether of measurable density there would be no friction except as the revolving ether of this solar system met at the outer confines the ether of other solar systems

I have studied to some extent the action of gases under compression and expansion having carried pressure to 10 000 atmospheres on liquids and gases and cannot help taking exceptions to the commonly accepted versions of some things such as the depth of the earth's atmosphere the character and density of interstellar atmosphere or ether as ordinarily known for want of a better name

One who has observed the actions of gases under varied temperature and from comparative vacuum to extremely high pressure, can hardly count the depth of earth's atmosphere in tens of miles but rather in thousands of miles before it approaches the extreme tenuity of space midway between earth and sun. Neither can one conceive of a vacuum produced by gravitational attraction In my humble opinion, as a student of physics and not as an astronomer, interstellar space is filled with hydrogen highly attenuated or helium or both.

In this vast ocean of space, there may be floating, unseen worlds of gas or gases invisible, yet each as capable of holding its individual position as part and parcel of this or some other solar system as are the more solid substantial and visible worlds.

Some years ago during the reign of Halley's Comet, I published a theory to the effect that a comet is a vast ball of luminous gas containing a central nucleus of *solid or semi solid particles of sufficient density to cast* a shadow under the light of the sun This explains the luminous tail of the comet the curvature of the tail, the invariable direction of the tail etc

A gaseous body cast off from the sun by some great eruption or explosion would obtain and maintain a spherical form with the heavier gases liquefied, frozen, or solidified in the center of the sphere The central portion or nucleus may be reasonably supposed to be liquefied gas with particles of solidified heavier gases floating therein at depths according to their density

Every body in space must have an atmosphere It need not necessarily consist of nitrogen and oxygen but, in their absence or of the heavier gases, there will inevitably be hydrogen or helium of a density in proportion to the size and weight of the central body

Gases liquefy more readily in proportion to their density and less readily as they become more tenuous Does the atmosphere of our earth become sufficiently reduced in pressure before a degree of cold sufficient to liquefy is reached? If not then there must be a continuous rain of liquefied air in the outer confines of the earth's atmosphere.

I trust that my observations may not appear as ridiculous to you as did to me a paper read by an "astrologer" before a scientific society in Los Angeles just before the visible period of Halley's Comet. He said that it would be a very wonderful sight when, on—(giving date of perihelion) the comet would "*swish around the sun*" GEO. H LEE

Omaha, Neb

Keeping an Army Supplied

How Fighting Men of Germany Are Victualled and Munitioned

By Dr Alfred Gradenwitz

NOTHING more strikingly illustrates the difference between the old and new methods of warfare than the evolution that has taken place in the victualling and munitioning services Though Napoleon, in most of his wars, was able to follow his famous principle that "war must feed war," he, very much to his detriment, experienced the limitations of this system

In wars of the present day, with their unprecedented numbers of combatants and novel and complicated exigencies, it is, of course, out of the question to attempt a course such as that suggested by the great general, the food requisitioned in occupied districts being at most a small contribution to the invading army's needs In fact, an army, to be really capable of prompt and efficient action, must carry with it all the divers things it stands in need of It is true that modern means of communication, in conjunction with the telegraph and telephone, afford a practically unbroken connection with marching and battling armies, on the one hand, and the base and home country, on the other, the electric spark allowing the requirements of the army to be signalled in a few moments to almost any distance, while a goods train, within 24 hours, brings the daily requirements of a whole army corps to a distance of 500 kilometers. In the victualing and munitioning of an army, nothing should be left to chance.

It is not generally realized how complicated an organization is required to keep an army permanently supplied with the food, ammunition, and sundry materials needed by the men and guns. Many, it is true, have a vague idea of the existence of what German soldiers in their own slang call "gulash cannons"—field kitchens taking the food to the men in the trenches or behind the firing line, but the fact remains that there is a prevailing ignorance among laymen in the matter of how an army is fed. They do not understand that these useful contrivances, of which, together with their supply wagons, there is one to every company, squadron and battery, are but the last link in a long chain of supply centers.

The field kitchen and supply wagon are fed from what in the German army is called the "big baggage"—an endless train of trucks following behind the army at from 5 to 10 kilometers distant and carrying not only food and ammunition, but also entrenching tools, sanitary material, reserve horses, fodder, and other war supplies.

In spite of the apparent magnitude of this train of wagons, the supplies of the "big baggage" at most suffice for but four to five days, and accordingly have to be continually replenished from the wagons and storehouses of the "army service" or "train," as it is termed by the Germans Between the latter and the "big baggage" there is a continuous stream of motor cars traveling to and fro And since not even the "army service" columns are inexhaustible, a continuous supply from the home country must be provided for How this is achieved will be best understood by referring to the other end of the long supply system connecting the home country with the armies in the field.

Each army corps has, in the home country where the army base commences, a supply center of its own where all the food, fodder and ammunition required are gathered and sent on to the collecting station Transport through the base proper now begins, either by rail, motor car, river barges, or other means, and continues as far as the district immediately behind the firing line.

Typical road behind the lines, showing the long streams of supply vehicles and men

Where regular railroads end, there is what is known as the base center ("Etappen Hauptort"), where not only the supply of victuals and ammunition, but also the field post and other military services are centered The farther transport is effected by means of field railways, motor cars, and the like, to the local base centers, the arrangement of which, of course, varies in accordance with the varying position of the army Since the same roads—which, as a rule, are only few in number and in a bad state of repair—serve for a number of other transports, such as for troops proceeding to the front and for wounded soldiers and prisoners returning to the army base, the army authorities often experience some difficulty in insuring a reliable conveyance of supplies.

From the local base centers the final distribution of supplies to storehouses behind the front is effected by means of "army service" columns or motor trucks, and from the storehouses the "big baggage" of the various army corps is fed in its turn.

The standard daily ration of German soldiers in the field comprises 750 grams of bread, 375 grams of meat, 1,500 grams of potatoes, 25 grams of salt, 25 grams of coffee, and 17 grams of sugar This, however, does not mean that soldiers get invariably the same amount of identical foodstuffs. In fact, these are merely standard quantities which, in accordance with the actual bill of fare, are replaced, partly or wholly, by equivalent amounts of other foodstuffs—bread, *e. g.*, by biscuits, potatoes by vegetables, rice by oatmeal, coffee by tea or cocoa, and so on.

In order to provide for emergencies, each German soldier carries about him what is called the "iron ration," which consists of a handful of food to be used only in cases of extreme need.

The food and ammunition supply of an army doubtless is one of the foremost features on which a military success eventually depends.

How Shrapnel Shell Is Made

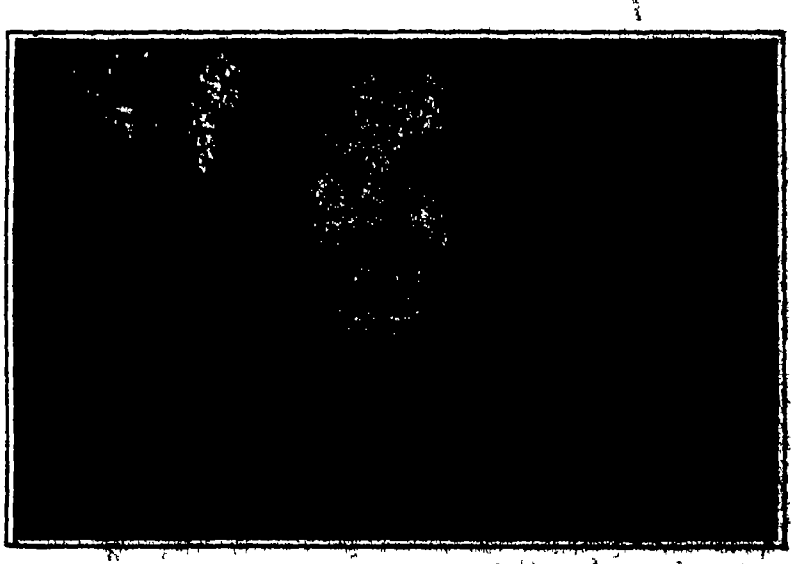
THE first shrapnel shell, invented in 1784 by Lieut. Shrapnel, was merely a cast iron ball filled with bullets and powder, which was exploded by a crude fuse, screwed into the shell This type was unsatisfactory, because bullets flew in all directions when the shell exploded. Later this defect was partially overcome by inserting a sheet iron diaphragm, which separated the bullets from the bursting charge. Modern shrapnel is similar in principle to its early predecessor.

A superficial examination of a shrapnel shell discloses little to indicate its destructive power—it is simply a small steel shell, attached to the end of a brass case, but when properly adjusted and fired from a modern field gun, this becomes a veritable demon of destruction. Within the brief period of 4¾ seconds it has traveled more than 1 mile, and 17¼ seconds later, it is nearly 8¾ miles distant from the gun.

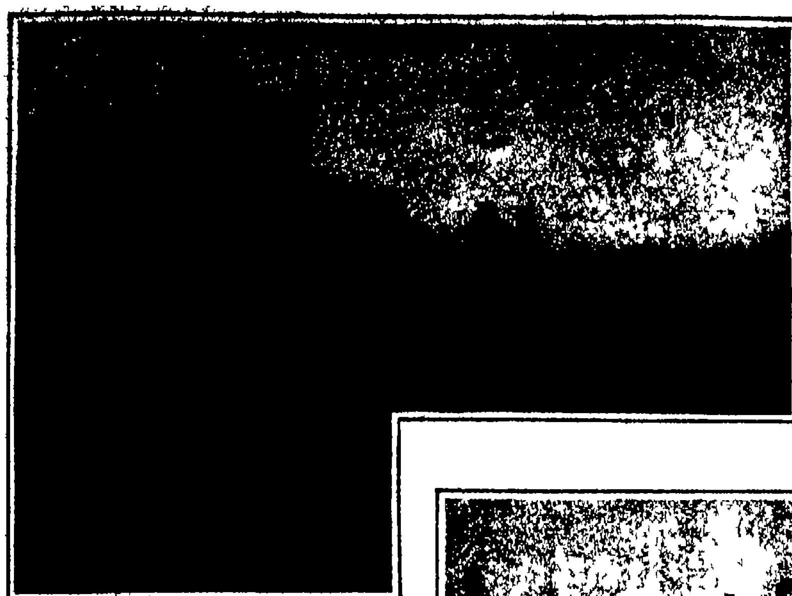
Each shell has a time fuse that is made with the accuracy of a watch This fuse is graduated in seconds, and is set to explode at a given range. As soon as the gun is fired, the fuse is ignited automatically, and when the explosion occurs in the base of the shell itself, the forward end is blown out and a shower of lead bullets hurled forward in conelike formation.

The velocity of these bullets exceeds the velocity of the shell at the time of the explosion by from 250 to 300 feet a second, and they cover a zone about 30 yards

Heavy, horse-drawn wagon used by the commissary division of the German army



Distribution of food and other supplies to a company of soldiers in the field



Horse-drawn cars carrying supplies behind the battle line

A column of soup wagons or so-called "gulash cannons"

A battery of German bake ovens and bakers in the field

wide and 250 yards long, on an average.

The shrapnel used by different governments at the present time are made on the same principle, but differ somewhat as to size and in the arrangement of the fuse, which is composed of a slow-burning composition that is pressed into annular grooves. One of these grooves is in a stationary ring and the other in a graduated movable ring.

By turning the ring the length of this fuse is varied so that the shell may be exploded at any time within a period of about 21 seconds. During this brief period a 3-inch American shrapnel will travel about 6,500 yards, or nearly 3¾ miles.

Shells of the 3-inch size contain from 210 to 360 lead bullets, about one half inch in diameter, which are embedded in a resinous mixture. This "matrix" as it is called, serves two purposes. It holds the bullets in position and also acts as a tracer to indicate by a cloud of smoke the point at which the shell explodes.

The interesting phases of shrapnel manufacture include the formation of the brass case, the forging of the shell, and the finishing of the various shell and fuse parts, to the degree of accuracy required. The making of a brass case 11¼ inches long, 3⅝ inches in diameter, for the British 18-pounder requires seventeen different operations. It is formed from a flat circular blank 6¼ inches in diameter and ⅝ inch thick.

As these cases, as well as those for other kinds of ammunition, contain about 65 per cent of copper, the importance of this metal in modern warfare is apparent.

The shell is forged to approximately the required shape, either in a powerful hydraulic press, a power-forging machine, or an ordinary power press, such as is used in sheet metal work. The presses used for forming these hollow shells from a solid billet are capable of exerting a pressure of several hundred tons.

For finishing the interior and exterior of a shrapnel shell many different designs of turning machines are in use. The tools are so arranged that one follows the other progressively, so that the drilling, turning, boring, forming and threading, are done rapidly and accurately. The exterior surface is finished smooth, and shaped to the proper size by a broad grinding wheel.

The final step in shrapnel manufacturing is that of assembling the different parts. A charge of black powder is placed in the bottom of the shell. Over this charge is a steel disk or diaphragm, and then the remainder of the space is filled with shrapnel and the smoke producing matrix. The time fuse is screwed in place at the forward end and covered with a soft metal case to protect the different parts. This outer case is removed just before using the shrapnel.

It is important that the steel from which these shells are made has sufficient strength to prevent any bulging of the shell when it is subjected to the enormous pressure at the time of firing.

An ingenious little instrument known as a scleroscope is used for making this strength test. This instrument has a small hammer, tipped with a diamond, which is allowed to drop upon whatever part of the shell is to be tested.

After this hammer strikes, it rebounds to a height depending upon the hardness of the steel, and as there is a definite relation between the hardness and strength, the graduated scale of the instrument indicates approximately what the strength is.

Potash Mines in Alsace

WITHIN a recent period, steps have been taken to operate the potash mines which were discovered in 1904 in the basin of Mulhouse. At the present time, one of the operating companies has a concession of 15 000 acres and is now working five shafts here. It is estimated that the total amount of product for the Alsatian region is no less than 300,000 000 tons, evaluated in potassium oxide (K_2O). Several different companies are now engaged in industrial operations in the district, the most important plant being the above mentioned one in the region of Mulhouse. In this case, the work first encountered a stratum of rock salt lying above the potash, which has about 8 feet thickness, while the potash strata are met with at a depth of 2 150 feet. This substance is sylvinite or chloride of potassium containing 30 to 44 per cent of the pure salt for the first stratum and 23 to 30 per cent for the second. Soundings on a large scale were first made in Wittelsheim forest in 1904 in which rock salt was found at 1,200 feet and strata of potash at 2,070 and 2 150 feet. This formation belongs to the oligocene period, and the geological data explain the method of formation. At first a basin existed here whose bottom was covered with soft water at the eocene period, then a sinking of the soil gave access to an arm of the sea in the oligocene epoch, as the sea then covered Belgium and part of France. This formed a natural evaporation basin with a narrow and often-barred channel, then came a new sinking of the soil, with irruption of the sea, then a gradual rise of the soil causing a separation from the sea. Thus fresh and sea water alternated here, resulting in various deposits down to the end of the tertiary epoch, according to surveys by German scientists.

One of the numerous field post offices near the front, for the receipt and distribution of mail

Interior view of a military storehouse, showing the huge quantities of supplies at hand

Panoramic Sight for Guns

THE panoramic sight is a special form of telescope which enables the user to look to the front, rear, or either side, in fact, to any quarter of the horizon without changing the position of his eye and to see erect images of the objects in view An application of present interest is the use of such sights with field guns in firing at objects that cannot be seen from the gun For example, should it be known that the gun in Fig 3 is on a straight line joining the target and a tree in rear of the gun, the movable head *A* of the panoramic sight could be turned directly to the rear, and the gunner looking into the fixed eyepiece *B* would know that when he was sighted on the tree his gun was pointing at the target. The tree could be in any position so long as the angle at the gun between the target and the tree were known in order that the head could be turned the proper amount.

The general construction is indicated in Fig 2. Should only the reflecting prisms at 1 and 2 be used, and all other optical parts be omitted, an object would appear upright when looking to the front inverted when looking to the rear and on its side when looking to the right or the left This may be readily demonstrated by holding two hand mirrors in the proper relative positions With the objective lens 3, but not prism 4, added to the system the object would appear inverted when looking to the front and upright when looking to the rear

The operation of the sight is dependent on the fact that if a prism of the form of 4 be rotated about its longitudinal axis, the image will rotate twice as fast as the prism Should a person hold such a prism in his hand so that an erect image were seen and then rotate the prism 90 deg, the object would appear completely inverted or to have rotated 180 deg

In the case of the two reflecting prisms the image rotates as fast as the movable prism, that is the head has to be turned completely to the rear before objects appear fully inverted but turning prism 4 90 deg also completely inverts the object, and therefore by constructing the instrument so that prism 4 rotates with one half of the velocity of the head, the two inversions neutralize each other and an erect image is seen

The rays of light when looking toward the front are indicated by Fig. 1 In this case the image is inverted by prism 4 and erected by objective 3 The image is reversed from right to left by objective 3, and the reversal is corrected by cross reflection from the lower inclined surfaces of prism 2

Fig 2 shows the path of the rays when looking toward the rear The image in this case is still inverted by the objective 3, but not by prism 4, which is now rotated 90 deg from the position shown in Fig 1 The inversion is corrected by double reflection from prisms 1 and 2. The image is reversed by prisms 1 and 2 acting as simple reflectors by objective 3, by prism 4, and by cross reflection from the lower inclined surfaces of prism 2. The net effect of these four reversals is that there is no apparent reversal, and the object has its normal appearance

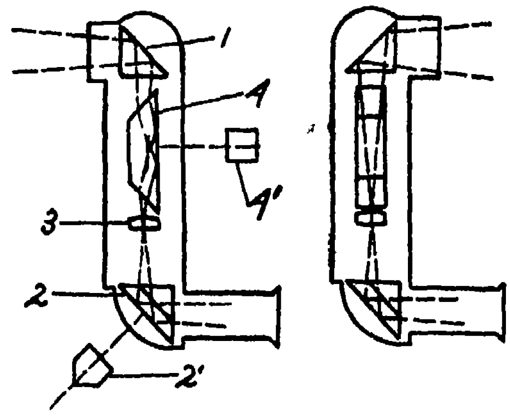
A similar analysis of any intermediate position of the revolving head will show that the object will always be seen in its true position

American Motorcycles for the European Fighting Men

ONE of the characteristic features of modern warfare is the use of the motorcycle in place of the horse by dispatch carriers and others. Although motor cars are being employed, to a great extent, for military purposes, there are conditions under which they must give way to the motorcycle The light weight and great power of the latter become paramount considerations when roads are rough and muddy, and when transportation accommodations for only one or two passengers are required

The uses to which the motorcycle has been put, aside from the carrying of dispatches, are manifold It has been found an ideal means of transporting officers from one point to another in a short space of time, in fact, the motorcycles can make a greater speed than the average automobile, with a greater degree of safety The two-wheeled motor vehicle has also been found indispensable for rapidly reaching different sections of a long supply train on the move for on such a mount an officer can cover several miles in the minimum space of time and thus keep in touch with every unit and man of the entire train Where roads are poor and even where they become mere foot paths, the motorcycle can be used.

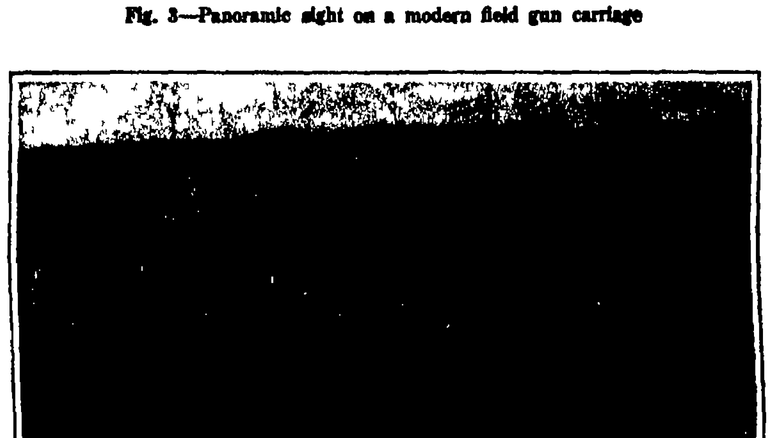
There has been experienced on the part of the military drivers the tendency of motorcycles to skid when traveling at high speeds over muddy roads. To overcome this danger, many of the military machines now in use are provided with standard side cars, which greatly reduces skidding while not reducing the speed to an appreciable degree. In the accompanying illustration are seen a number of American motorcycles now being used by the motor truck division of the Spanish army It will be noted that, in conformance with the latest lessons of the European war, these machines are provided with side cars.



Figs. 1 and 2—Principal optical features of panoramic sight and path of light rays when looking to the front and when looking to the rear

The parts shown in Fig 1 are 1—Reflecting prism mounted in movable head which can be turned horizontally in any direction 2—Fixed reflecting prism 2'—Cross section of 2 3—Objective lens. 4—Prism rotating with one half the angular velocity of the head. 4'—Cross section of 4

Fig. 3—Panoramic sight on a modern field gun carriage



American motorcycles with side cars used by the automobile truck division of the Spanish army

The Fur Seals of the Pribilof Islands

THERE are in existence only two important herds of fur seals, one of which has its breeding grounds in the Commander Islands, belonging to Russia, the other in the Pribilof Islands, belonging to the United States Of these the latter is much the larger The Pribilof Islands are Government property, and thus it happens that the United States Government finds itself the owner of by far the most valuable herd of fur seals in the world This unique bit of property has been a source of much tribulation—as everybody knows.

Fur seals are, to all intents and purposes, domestic animals. The herd returns year after year to the same breeding ground; indeed, the "bulls" most frequently choose a particular spot on the beach during their first breeding season and occupy it, with their "harems," ever afterward, during the months they spend ashore. At this period the herd is entirely at the disposal of man, the animals may be driven up, counted, caught, examined, branded or killed even more easily than range cattle. Thus the control of the herd is a comparatively simple matter, provided the animals are immune from destruction by man during periods of absence from the breeding ground—i.e., when feeding or engaged in their annual migration—and this immunity was secured by the treaty abolishing pelagic sealing, effective December 15th, 1911.

This treaty, however, which was to run for 15 years, did not terminate the interest of other nations in the Pribilof seal herd. To compensate them for giving up the privilege of pelagic sealing the United States pays to Great Britain and Japan 15 per cent of the profits of land sealing at the Pribilof Islands, and a similar payment is made by Russia in connection with the seals under her control.

These facts explain the large amount of attention that has been devoted to a biological problem connected with a small group of rocky islands in the midst of Bering Sea

The latest of the many scientific commissions that have visited these islands, under official auspices, for the purpose of investigating the seal herd has recently rendered its report.[1] On August 24th, 1912, Congress passed a law prohibiting all killing of fur seals on the islands for a period of five years, except the number needed as food for the natives, and providing for a breeding reserve of not less than 5,000 3 year-old males annually during the life of the treaty suspending pelagic sealing In order to ascertain the effect of these measures, and to help settle various points in dispute as to the future regulation of the herd, the Department of Commerce decided to send to the islands a commission of three experts who should be free from previous interest in the fur seal controversy and therefore unprejudiced Accordingly the president of the National Academy of Sciences, the secretary of the Smithsonian Institution, and the Secretary of Agriculture were requested to make nominations. Their nominees, all of whom accepted appointment, were, respectively, Prof. George H. Parker, Wilfred H Osgood, and Edward A. Preble They spent the summer of 1914 at the Pribilof Islands, and were accompanied by two representatives of the Canadian government and one of the Japanese government.

While it is impossible to summarize here the voluminous report of these experts—dealing, as it does, not only with the seals, but with the animal life of the islands generally—two of their most important conclusions may be noted. One is that the fur seal is by no means, as has been popularly supposed, on the verge of extermination The other is that no justification exists for the present closed season. Commercial sealing, under proper restrictions, should be resumed at once.

The herd now contains approximately 294,000 individuals, of which not less than 93,250 are bearing females.

Earth Shocks Due to Frost Cracks

IN the annual lists of earthquakes registered at the Harvard Seismographic Station occasional shocks occurring in winter are noted as due to "frost cracks;" i. e, the sudden opening of fissures in the ground resulting from freezing. Prof. Woodworth, director of the station, states that the late Prof. Shaler, in one of his lectures, mentioned the occurrence of a sensible shock at Cambridge some forty years ago, which he traced to a crack in the frozen ground. An apparent earthquake near Akron, O., probably due to a frost crack, was described in the *American Geologist*, vol 1, 1888, p. 190-192, while another, which caused a mild panic at Attleboro, Mass., was reported in the *Attleboro Sun* of January 23rd, 1908. Prof. Woodworth says that "this idea of frost cracks is very widespread in New England as an explanation of many small shocks coming at a time when the frozen ground is known to have cracked open."

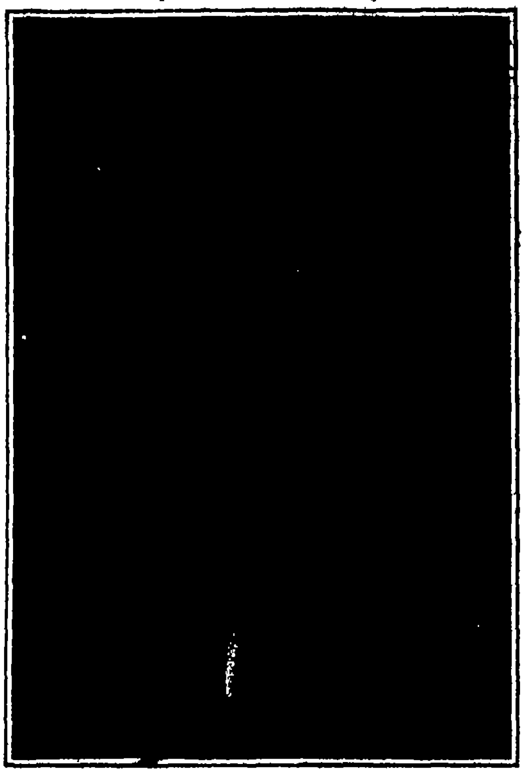
[1] The Fur Seals and Other Life of the Pribilof Islands, Alaska, in 1914. From the Bulletin of the Bureau of Fisheries, Vol. XXXIV. Issued June 19th, 1915.

What Is a Comet's Tail?

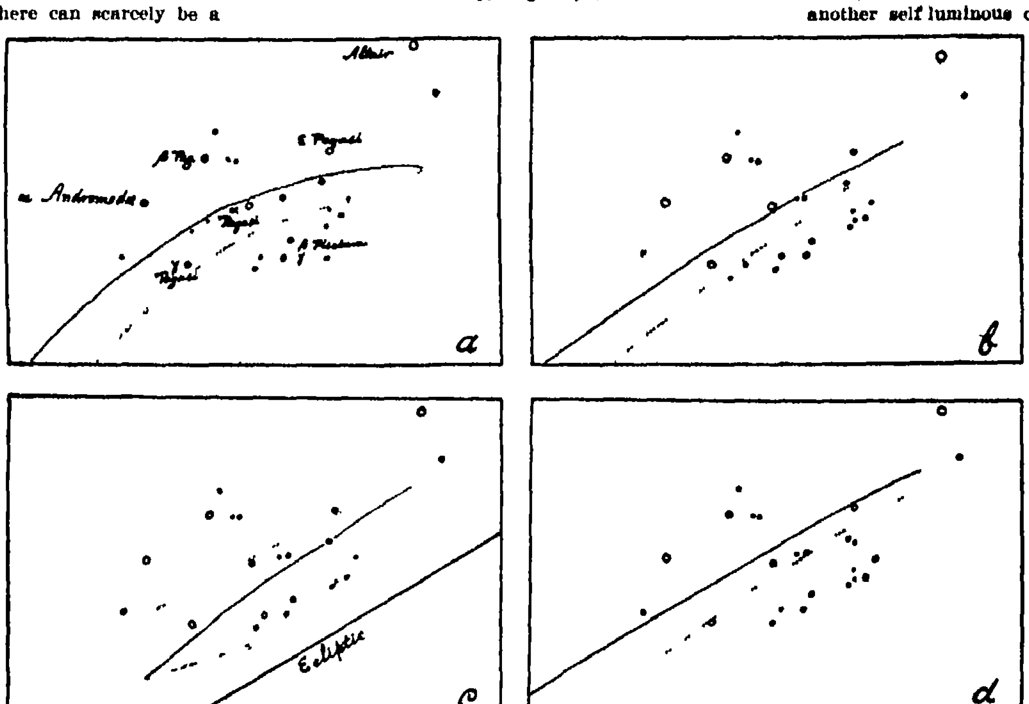
Some New Results from the Recent Appearance of Halley's Comet

By Frank W. Very

MOST of the readers of the Scientific American presumably looked at Halley's comet when, in the latter part of May, 1910, it appeared night after night in the western sky, but if they did not, few of them will be likely to live to see it return, since that will not happen for about 70 years. Few, however, were probably enterprising enough to get up at 3 A.M on the mornings of May 17th to 19th 1910, when the comet was rapidly approaching the line joining sun and earth but before its supposed, though unobserved transit across the sun's face On those mornings, its immensely long, and straight tail stretched, like the beam of a great searchlight, obliquely from the eastern horizon nearly to the Milky Way, and it was certainly one of the most impressive spectacles that the writer has ever seen The swivelling of the tail between these dates, as seen from our position in space, is of some interest in respect to the question whether the earth actually passed through the tail The comet's tail certainly approached very near to that imaginary line among the stars which defines the intersection of the plane of the earth's orbit with the celestial sphere and at a time when the nucleus was almost in line with the sun, and then receded If the extension of the tail was great enough, and its pointing true enough, its most attenuated tip may have touched the earth for a brief interval There can be no difficulty in respect to extension Prof Barnard made the length of the tail at this time "at least 120 deg" The writer's eye estimate was 115 deg according to which the extension was far beyond the earth's orbit. This was also suggested by the steady tapering of the luminous beam towards the tip, assuming that this represented at any rate, a very definite branch of the tail There can scarcely be a doubt that this was an effect of perspective, and that we were viewing an approximately cylindrical shaft of light, narrowing as it vanished into the distance The writer made the breadth of the tail at its widest part 5 deg on the morning of the 18th (civil), and the next morning, when we were still nearer, Barnard found the breadth 10 deg After passing over a dark gap on the lower (southern side of the tail), an exceedingly faint, diffuse luminous haze was noticed by Barnard, which stretched on either side of the ecliptic trace, and to the horizon. This may have been a second, still nearer branch of the tail, at least 20 deg broad In agreement with this view, my notes make the south border of the upper branch very diffuse, as if there were more to come on that side



Halley's comet, May 5th 1910, photographed at the Lowell Observatory, Flagstaff, Arizona

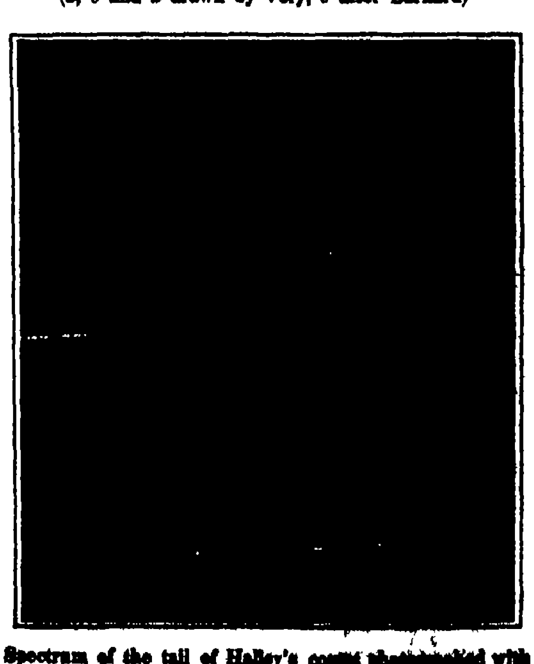


Tail of Halley's comet at 3 A. M. (a) May 17th, (b) May 18th, (c) May 19th and (d) May 20th (a, b and d drawn by Very, c after Barnard)

Many observers in different parts of the earth witnessed halos and coronas of exceptional brilliancy about either sun or moon on the 19th of May at the time or soon after the time of closest approach. At the Yerkes Observatory Prof Frost noted irridescent clouds of remarkable brightness from noon until 1 P.M, and the unusual phenomenon of a halo of 15 deg radius Prof Max Wolf, of the Königstuhl Observatory, reported a twilight of long duration and exceptional intensity with three successive purple twilight glows, and a "Bishop's ring" about the moon, more intense than any he had ever seen, of a diameter of 56 deg, which indicated the presence in the atmosphere of vast numbers of particles, one and a half thousandths of a millimeter (about six one-hundred thousandths of an inch) in diameter Many observers noted the ordinary solar halo 45 deg in diameter, and due to ice crystals, which is fairly common, but these crystals might, in this instance, have been condensed on cosmic dust. The Bishop's ring and twilight glows are rare phenomena commonly associated with the presence in the upper air, of excessively comminuted dust from volcanic eruptions None of these appearances are so entirely exceptional that they might not have been earth born, and yet their presence at just this time strongly suggests a cosmic origin If this is a fact, we are at liberty to surmise that some of the light from a comet's tail is reflected from dust particles, originally thrown off by explosive eruptions from a cometary nucleus which, even if it be only a few miles in diameter, must become heated to incandescence under the sun's rays beneath a highly absorbent atmosphere of carbonaceous gases. Brilliant jets, which are probably eruptions of dust laden gas, are frequently seen to issue from the nucleus of a great comet and expand into the coma. Some of this dust must be highly electrified and, if so, may be electrically repelled into the tail where it is seized by other forces, namely, those of the pressure which sunlight exerts on exceedingly fine particles. By the pressure of sunlight, the dust is then sent spinning into space This, at least, is the supposition. We shall see how it has been brought to the test when applied to this comet.

We next appeal to the spectroscope, and find that the head of Halley's comet gave out considerable light having a continuous spectrum, that is, one in which every color of the rainbow is present in a graduated series. Such a spectrum might be produced with light emitted by incandescent dust, or if rich in blue and violet light, it is more likely to represent nothing but sunlight reflected from cooler, but solid, rather than gaseous material In fact, this criterion of the presence of violet and even of ultra violet light, as well as the observation of the stronger dark Fraunhofer lines of the solar spectrum, definitely decides that there was a considerable admixture of sunlight in the light from the comet's head. Farther away from the head, however, during most of the comet's shining, this continuous spectrum became much fainter and at length was too feeble to affect the photographic plate. Whatever solid dust there was in the extension of the tail at such times, reflected much less light than was given out by another self luminous constituent. But even if there were not dust, this would not necessarily prevent dust effects in our atmosphere, because swiftly moving molecules, or electrically dissipated cathode or anode particles of smaller dimensions than molecules and too fine to reflect sunlight, might serve as nuclei of condensation on entering the atmosphere. Upon these nuclei, minute ice crystals could be built up The process and the resistance of the air would soon slow down the enlarged particles, leaving them to hang suspended in air for a while as halo-forming dust.

We next ask what the spectroscope has to say in regard to the presence of molecules in the comet's tail, for if these are present, the spectrum should be one of discontinuous colored bands, and here I may refer to some beautiful, objective-prism spectrograms of Halley's comet taken on isochromatic plates at the Lowell Observatory No slit whatever was used at the usual slit end of a collimator, as in the ordinary spectroscope, but instead, the image of the comet was formed directly by a telescope whose objective was covered by a large prism The image itself was then virtually its own bright slit, and this image was multiplied by the prism as many times as there were different sorts of light. This was possible in the present instance, because the light of this comet's tail through a considerable part of its career, and unlike that of its head, consisted mainly of only a few special, colored rays, principally of blue and green light, and these formed as many separate images of the tail, complete in every detail, each a duplicate of the others, but in a different part of the spectrum There were not enough images, nor too closely spaced, to spoil the picture by overlapping. These successive images impressed upon the photographic plate, where their positions and consequent wave-lengths of the luminous rays could be accurately measured, conveyed the following important information:



Spectrum of the tail of Halley's comet photographed with an objective prism, without any slit, May 29th, 1910, at the Lowell Observatory, Flagstaff, Arizona

On May 29th, at a distance of 3 to 6 deg. from the head, there was found in the light of the tail 80 per cent of emission bands due to carbon monoxide (a gas whose molecules are composed of one atom of carbon united to one atom of oxygen), and 20 per cent of continuous spectrum. "From April 29th to May 7th," says Dr. Lowell, "the tail spectrum was almost wholly

(Concluded on page 160.)

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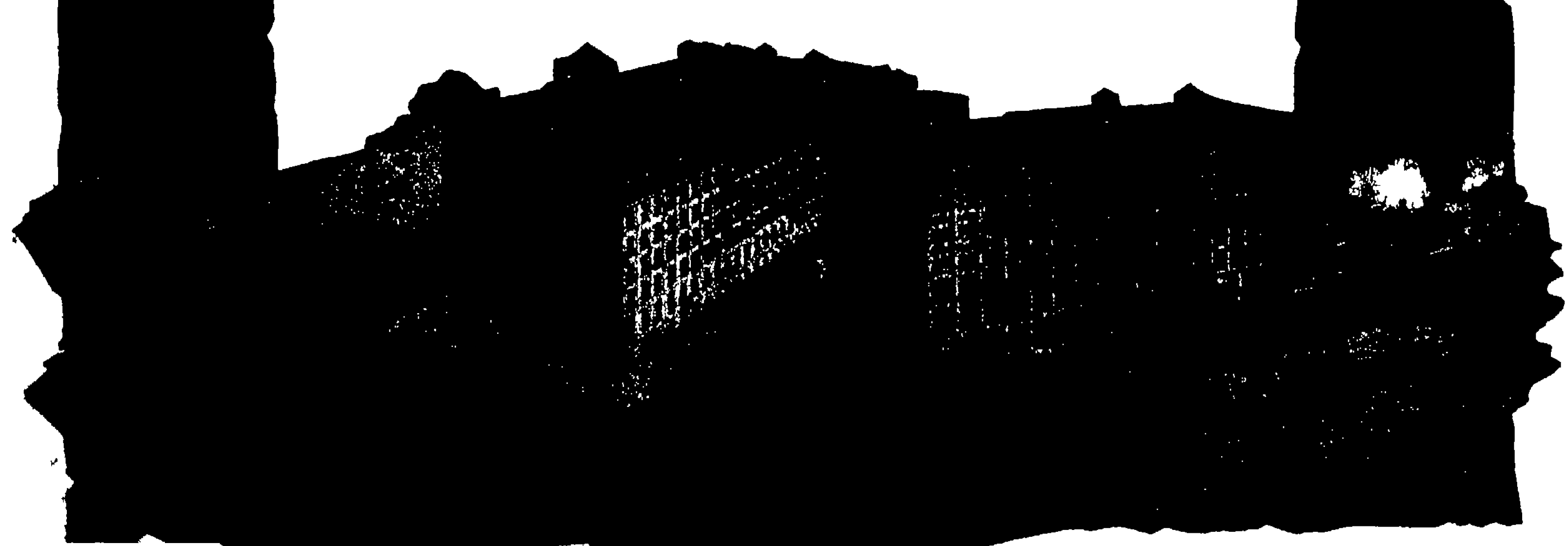

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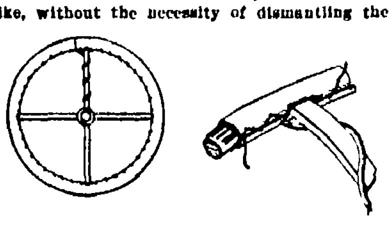
RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Electrical Devices

ELECTRIC HEATER FOR STEERING WHEELS.—G H BARNES, Stanbridge East R M D No 3 P Quebec Canada This invention provides a heating means which may be readily attached to the steering wheel of automobiles motorboats aeroplanes and the like, without the necessity of dismantling the



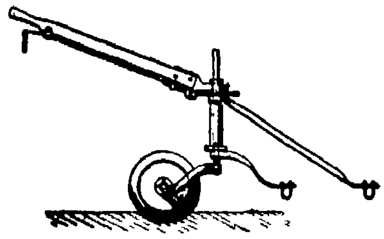
ELECTRIC HEATER FOR STEERING WHEELS.

wheel in any way or of boring or otherwise mutilating it The invention avoids the necessity of using brushes or movable contacts The heating medium also serves as an efficient gripping member for the wheel thus preventing the hands from slipping

Of Interest to Farmers.

MILKING STOOL.—I H CHASE 232 Fillmore St Denver Colo This invention provides a stool formed of metal for the major portion to give the requisite strength and permit of thorough cleaning of the stool when desired provides a stool so formed that a flaring milk pail may be placed in proper and convenient relation to the stool when milking provides a stool having means for the support of a water pan whereby to wash the cow's udder and provides a support for heating the water when desired

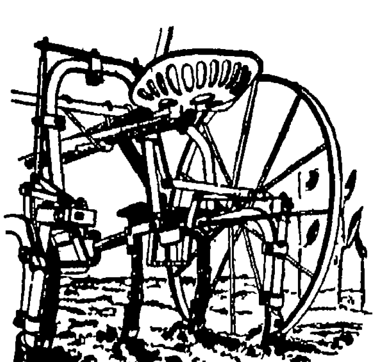
STEERING DEVICE.—N P NELSON New berg Ore The invention has particular reference to a reversible handle for steering devices It provides a device which may be employed in connection with any character of machine, such as seed planters and other



STEERING DEVICE.

agricultural machines and the like, the device including a caster wheel having a spindle extending through a bearing provided with a touched plate adapted to be engaged by an adjustable part of the handle whereby the latter may be releasably held in any adjusted position.

CULTIVATOR.—A J KIEFFER, Nevada Ohio This invention provides a cultivator attachment in the nature of a device to be attached to, or made a part of, a riding cultivator, for controlling the operation of at least one of the shovels or other ground engaging



CULTIVATOR

gaging tool in such manner that these shovels or tools may be shifted to lie at an angle with the direction of travel of the cultivator, so that, as the latter moves along the shovel gangs will be moved to the right or left, as the case may be, by the action of the ground against the shovel or tool in order to avoid cutting or uprooting the plants being treated.

Of General Interest

METALLIC PACKING.—R. H ALDRICH, Allentown Pa The object here is to provide an efficient packing which is characterized by the provision of a metallic yieldable ring, which carries a resilient member adapted to contract the metallic ring when pressure is applied to the said metallic ring

MEANS FOR LABELING RADIOGRAPHS.—A DE YOANNA, 565 Henry St., Brooklyn New York, N Y This invention relates to a means for labeling X ray photographs commonly known as radiographs, and has for an object the production of a label forming part of the picture It provides a label for a radiograph which forms part of the picture and which may contain any desired information and may be arranged so as to appear on any part of the negative

BUTTER MOLD.—R J CORNEBOON, Buena Vista Colo One of the objects of the invention is the provision of a mold consisting of hinged sides and ends having pivoted clamps for retaining them in closed position, a press block being vertically movable between said sides and ends and detachably carried by an adjustable operating rod

Hardware and Tools

DETACHABLE COMBINATION LOCK.—G T OLDHAM, 74 Cortlandt St, New York, N Y This improvement has for its object to provide a detachable combination lock having a shank with a lateral shaft for disposal in an opening in a key plate a combination lock ing device being mounted on the shank for cooperating with teeth on the edge of the shaft

WELL TILE PLACING TOOL.—G H CARR, Marcus Iowa This invention relates to a tool for placing well tiles in position one on top of another An object is to provide means for locking the tile gripping elements in gripping position and in conjunction therewith an automatic device for unlocking the said locking means so that the tool will be released from the tile

Heating and Lighting

FUEL SAVER.—J MANDEL 2139 Lexington Ave New York, N Y The invention provides a sort of drum construction to take the place of a section or joint of stove pipe or furnace flue, the same being provided with means automatically operated by the draft created upwardly in the pipe or flue, to cause a certain amount of downward pressure or draft of fresh air which combining with the gases tending to escape will create a condition of uniform draft and nearly perfect and complete combustion

Household Utilities

COFFEE AND TEA STRAINER.—H N NEWTON 614 Bainbridge St Brooklyn New York N Y This invention relates to improvements in straining devices and particularly to a coffee and tea strainer, and has for an object to provide an improved structure which may be readily applied and which may be readily assembled and disassembled

CURTAIN ROD.—P ALTSCHUL, 9 E 40th St New York, N Y The object here is to provide a curtain rod which is hingedly mounted on the window frame at one end and is releasably fastened with respect to the window at the opposite end whereby the curtain can be swung bodily outwardly away from the window frame for various purposes as cleaning the window panes, hanging the shade etc

DRAIN COVER.—D J CONNELL, 412 North Washington St, Butte Mont This invention relates to drains, as in kitchen drains and main object thereof is to provide a readily applied and as readily removable cover therefor which will enable a housewife to use the sink for washing dishes, clothes and the like, to avoid the necessity for using an unsatisfactory dishpan or for carrying sufficient hot water to a washtub to use the latter

Machines and Mechanical Devices

SAFETY CLUTCH FOR FEED CUTTERS.—M A PAULSON and C FREDERICKSON Address the former Rice Lake, Wis. The invention relates to clutches, and the main object thereof is to provide such devices which are applicable to feed cutters whereby the cutters may be stopped, as by a hard substance in the feed being cut, without affecting the operation of the mechanism for actuating said cutters

METHOD AND APPARATUS FOR DEFIBRATING FIBROUS VEGETABLE MATERIALS.—G J MAHIEU Caix 221, Rio de Janeiro, Brazil The invention relates to the removal or extraction of fiber from various vegetable material containing the same, and to cleaning all such fiber in order that the latter may be used in various arts. The invention avoids severity of action upon the fibers during the process of separating other vegetable material therefrom

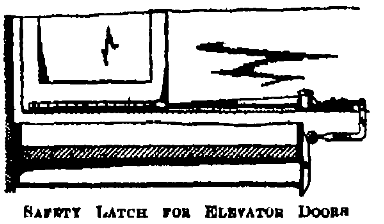
FLEXIBLE DRIVE MOUNTING.—M S. YOUNG 1892 Iroquois Ave, Detroit, Mich This invention provides a drive mounting which will constitute a support for the drive wherein the drive can be displaced to obtain the tight ening of the flexible transmission member without any disturbance of the parallelism of said drive with reference to the mechanism driven therefrom

MACHINE FOR STRIPPING, DYEING AND WASHING SILK.—G A CARSON, 156 Preakness Ave., Paterson, N J This invention relates to machinery for treating fabrics and has particular reference to means for treating skeins of thread, yarn or the like. The invention provides a means for rapidly and economically operating upon skeins of raw silk.

YIELDING COUPLING.—E. H. SIMONS and R. KLEIN, Weinheim, Germany In this invention the power transmission is obtained by means of blade springs, the latter being connected to one coupling member and bearing upon the faces of the other coupling member In constructions of couplings of this kind the blade springs bear upon the driven face of a coupling member not at right angles to the direction of the peripheral force and possess the drawbacks that the springs are influenced by lateral forces which result in rapid wear and even fracture of the coupling These couplings are not suitable for transmitting high power The present invention eliminates this drawback.

FOUNTAIN BRUSH.—H REICHE, South Somerville, N J This invention relates to certain improvements in devices for mechanically treating surfaces, and also for applying thereto a liquid or solid substance The device consists primarily of a brush which is connected to a handle inclosed means for operating the brush and delivering thereto the treating material

SAFETY LATCH FOR ELEVATOR DOORS.—C O MARX, 194 Crystal St, Brooklyn, N Y This invention has particular reference to latch means arranged to be tripped by the car to permit the door to be manually opened



SAFETY LATCH FOR ELEVATOR DOORS

or closed by the elevator attendant and to cause the automatic latching of the door at the interior as the car starts away from the landing in either direction

Musical Instruments

STRINGED MUSICAL INSTRUMENT.—N R BOSWELL and E D WILBER, 601 Hodges Bldg, Detroit, Mich The improvement provides a musical instrument arranged to enable the beginner to learn to play the instrument in a comparatively short time This is accomplished by providing a movable finger adapted to produce chords when placed upon the strings at certain places

Prime Movers and Their Accessories

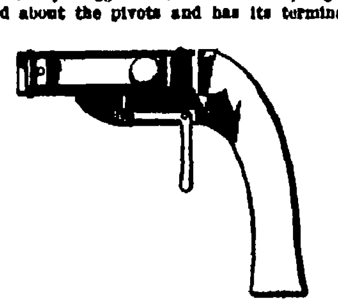
FUEL VAPORIZING DEVICE FOR INTERNAL COMBUSTION ENGINES.—L B WHITE, Manson, N C The improvement provides a device by means of which kerosene or other heavy oils which are not so volatile as the lighter oils such as gasoline can be used successfully in internal combustion engines. It provides a device by means of which the heat of the exhaust which is ordinarily wasted is utilized for heating a liquid fuel to its vaporising temperature

IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES.—H C WELL, Room 1201, 110 W 140th St. New York, N Y This improvement provides a system having a rotatable means for closing an open circuit connected with the spark plug of the engine. It also provides driving means for the rotatable means, which is operated by the piston rod of the engine.

COOLING SYSTEM.—E P CULVER, care of Peck Coal Co Portchester N Y This improvement is characterized by the combination of the thermosiphon system of cooling with the force system of cooling It provides a cooling system for internal combustion engines, which system will require but a small volume of cooling medium and consequently will be of small capacity although the engine will be perfectly cooled

Pertaining to Recreation

TOY GUN.—O W MALONEY, Box 486, Tulsa, Okla The invention comprises a stock to which are secured a pair of pivoted members, the free ends of which are normally held together by trigger mechanism A spring is coiled about the pivots and has its terminals



TOY GUN

engaging the free ends of said members so that when the trigger mechanism is actuated the members are forcibly spread apart and operate to eject a projectile from a propelling device secured to the members adjacent the free ends thereof

AUTOMATON.—R. J. SCHUMMANN, 4523 South 3rd St., Louisville, Ky This improvement provides a device with means for moving the same incidental to and in correspondence with the action of a vehicle; and provides means for moving certain portions of the automaton in simulation of the movement of a human figure, to produce an amusing and interesting impression on the observer

CAROUSEL.—W F, MANGELS, Coney Island, New York, N Y This invention relates more particularly to a carousel of the portable or knock-down type. It provides a novel column structure and mounting therefor whereby the column can be easily and quickly put up or taken down, and whereby the column will be strongly and rigidly braced.

TOY PISTOL.—L S BIXLER, care of Kenton Hardware Co, Kenton, Ohio. This invention provides a toy pistol having an anvil within the pistol casing with a recess in the casing in front of the anvil so that a projection on the hammer will be disposed over the anvil and in the recess when the hammer is seated on the anvil, to prevent sparks from flying when a cap is exploded against the anvil The hammer is constructed to form a continuation of the upper surface of the casing when the hammer is seated against the anvil.

GAME APPARATUS.—L M KRANER, Cloverdale Ore The primary object here is to provide a game of skill that may be played by parties of both sexes either indoors or out, whereby to furnish amusement and moderate exercise for the body without running or stopping thus affording wholesome recreation and pleasure

COMBINED FLYING AND SPINNING TOP.—B E LLOYD, 257 8th St New York, N Y This invention relates more particularly to flying and spinning tops of that type in which the flying element is given a high rotative speed by being moved quickly along a screw and finally thrown off the same, whereby the said element will fly through the air and ultimately light on the ground, floor or other surface and spin until its force is expended

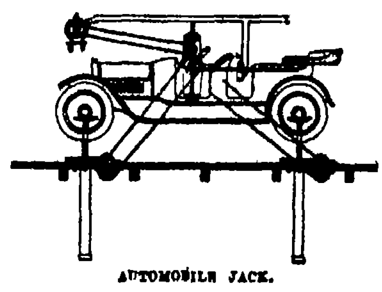
Pertaining to Vehicles

MOTOR VEHICLE SPEED CONTROLLER.—T DOUGLAS, 80 Maiden Lane, New York N Y The present invention relates to motor vehicle controllers particularly suitable to motor vehicles propelled by internal combustion engines and especially to those controllers which are designed to control the maximum travel speed of the vehicle to a speed proportionate to the load carried by the vehicle.

BLOWER FOR SIGNALING DEVICES.—NELSON NYBERG, 420 San Antonio St., El Paso Tex In the present patent the blower consists of a seat having upper and lower compartments divided by a partition having a valve opening, with which a valve coöperates there being springs for holding the top of the upper compartment extending upwardly so that as the occupant of the seat is moved up and down by the unevenness of the road, air will be drawn in through valves in the bottom of the lower compartments and this air will pass through the valve opening in the partition of the upper compartment, where it will be compressed to be fed through a pipe to a pneumatic signal controlled by a valve in the pipe

AUTOMOBILE CRANKER.—J D WELLIVER, Milford, Pa Among the principal objects of the invention is to provide a mechanical cranking device adapted to be easily, quickly and reliably attached to the ordinary mechanism of an automobile motor which may be operated by the driver of the car while seated in his place.

AUTOMOBILE JACK.—C E. DAVIDSON Ozona, Tex This invention relates to a hoisting apparatus, and more particularly to an automobile jack adapted for use in lifting the vehicle after the same is stored in a



AUTOMOBILE JACK.

garage, whereby a constant pressure on the tires will be avoided and the making of necessary repairs facilitated The invention comprises a plurality of casings mounted in and extending below the flooring of the garage, each of said casings having a lifting member in the form of a screw spindle vertically movable therein.

Designs

DESIGN FOR A DOLL OR STATUETTE.—R. S. HALEY, 10148 101st St., Edmonton, Alberta, Canada. The head of the doll has long flowing hair, with an aquiline nose, long eyebrows, and a long beard extending from the chin, the body being nude, with a slightly extending abdomen and with prominent toes.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

What Is a Comet's Tail?

(Concluded from page 156)

emissive [that is, composed of bands due to light *emitted* from glowing gas]. On May 11th it had changed to one nearly continuous [or, as explained above, the light was sunlight reflected from dust] While on May 23rd it had become largely emissive again and grew more so as time went on." Thus, at the time when those portions of the tail were being thrown off which reached the position of the earth on May 19th, there was an unusual prevalence of dust in the cometary emanation, and to this extent, at any rate, there is evidence favoring the supposition that the atmospheric dust effects if of cometary origin, may have been directly due to cometary particles, and not necessarily to secondary nuclear enlargements of an otherwise invisible molecular emanation The gaseous tail was confined to rather narrow streamers which were often *bifurcated in a peculiar way* The dust tail, always simultaneously present, even though it may have been the fainter of the two, which was practically the sole appendage from May 11th to May 23rd, 1910, had an entirely different shape from the gaseous tail The dust tail was broader than the gaseous streamers and included them without sharing their structure Its borders at some distance from the head were also diffuse, especially the southern border on the mornings of May 18th and 20th (civil date)

During a large part of the comet's appearance, strong ultra violet bands were observed in its spectrum, produced by glowing cyanogen gas, a highly poisonous substance consisting of two atoms of carbon and two of nitrogen in one molecular union This spectrum, however, though it became very strong in the latter part of May and early in June, never extended much beyond the limits of the coma, or head of the comet Apparently, a high temperature was needed for its exhibition The hydrocarbon spectrum also, which was very strong in the head, faded rapidly in the tail and was entirely lacking after the first half degree But the spectrum of carbon monoxide, not noticeable near the nucleus, rapidly increased in intensity on passing into the tail and continued unabated to distances of many millions of miles from the head Through out its course the excessively rarefied gas must have experienced the cold of space What, then can have been the process by which the light was produced. Can it have been of the nature of an auroral glow from a continuous electric discharge? Or is there enough attenuated oxygen gas in the interplanetary spaces to progressively consume the hydrocarbons as they pass through it, so that we are looking upon a multitude of tiny flames which appear continuous merely because they are innumerable, and which are continually disappearing to begin again at other widely separated points in space? We can not decide these questions offhand, and must wait for further information.

For a brief duration, the bright lines of sodium appeared intermittently in the spectrum of the head near the nucleus, especially on the hotter side toward the sun showing that at these times the temperature of the nucleus must have been near enough to incandescence to disengage the vapor of this substance which, in the metallic form, distils at about 900 deg Cent but might be separated from some of its compounds at somewhat lower temperatures. This gives us a suggestion of the almost volcanic turmoil which must be going on at the nuclear surface Under these circumstances, the solids of the nuclear surface become pasty The gases in the pores of the solid material are then emitted, bubbling out as from the frothing pumice of a lava cone to form an atmosphere extending to a great distance, because the gravitational attraction of the central mass is too feeble to retain or condense such an atmosphere within a narrow compass. The gases are thus readily separated from the main body and are emitted in considerable quantity, at first towards the heat-producing sun; but eventually they turn backward in a direc

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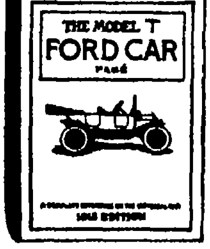

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tion immediately opposite to the sun, though not always with complete regularity. There are fluctuations both in the length and the brightness of the tail, and these are probably connected with the thermal vicissitudes in the nucleus.

The path of the gaseous particles is a blend of their original orbital motion and a new and more rapid velocity imparted by the action of sunlight. This action, foreseen by Maxwell, but actually discovered by the Russian physicist, Lébédeff, and applied to explain the formation of comet's tails by our own Nichols and Hull, is a sunlight pressure whose effect becomes very great when the masses of the particles are small and their dimensions approach molecular size The particles are then repelled at so great a speed that they reach the utmost limits of the tail in a very few days, and then cease to glow, either because they are no longer incandescent, or are consumed, or possibly because they are so widely separated that they no longer conduct electricity The tail seen at any one time is therefore not the same tail that is witnessed some days later The latter is a wholly new formation This was well shown when, on the evening of May 20th, the head of the comet having passed between us and the sun (or from the morning, or western elongation, to its evening, or eastern elongation), was seen by Barnard in the west one half deg in diameter, the nucleus like a yellow, nebulous, second magnitude star, and its spectrum was photographed by Slipher, but with not enough tail to be certain of it. Remnants of the huge 120-deg tail were still visible in the morning sky, but the new tail which was to be seen in the evening on later dates, had not yet formed.

In order to confirm the hypothesis that the velocity of particles in the tail is truly produced by the pressure of light, it was highly desirable to measure this velocity Dr Lowell, having at his command some 200 photographs of Halley's comet, taken at his observatory between April 18th and June 6th, 1910, set himself the task of detecting a sufficient number of knots, or observable irregularities in the tail, to be able, by timing their progressions, to deduce a series of values for the linear velocity of a particle at different distances from the nucleus If the light pressure in question is really acting, it should give a continually increasing velocity as the particle recedes from the nucleus. If, on the contrary, the original velocity has been given by some impulse, and there is no light pressure, the solar attraction will continually retard the motion. The following observation, which was made by Dr Lowell on the evening of May 23, 1910 definitely decides in favor of the light pressure theory

TAIL OF HALLEY'S COMET

	Angular distance from the nucleus to the point measured in the tail	Velocity of the point of the tail away from the nucleus.
Knot 1	1 28	13 6 miles a second
Knot 2	3° 12	17 2 "
Knot 3	4° 36'	19 7 " " "
Knot 4	6 15'	29 7 " " "

The result is given in its original tabular form, because it seems to the writer that the figures are more impressive than any description which he could offer The swiftest velocity amounts to over 2,500,000 miles in one day Similar, but slightly greater velocities were obtained by Prof Barnard for a different knot on June 6th, 1910 completely confirming Dr Lowell's measurement as to the fact of accelerated motion. That the increment of the velocity is not perfectly regular, is due in part to the difficulty of identifying the precise center of a vaguely defined knot. But in part such variations are presumably due to collisions between rival masses, and were to be anticipated. The very forms of the knots suggest local disturbances and whirling masses.

Another fact of very great importance appears when the observation is connected with further information given by the spectrograms. A simultaneous photograph of the spectrum of the tail, made by Dr. Slipher, showed that the tail was composed mainly of gases, on this date. The spectrum was almost wholly a band spectrum. Consequently the [illegible] whose motion was viewed in the [illegible] [illegible] particles of solid dust. Thus was settled in the most positive manner the dispute as to whether molecules do, or do not share in the repulsion which light had been shown to exert upon solid dust particles. We now know that the molecules are certainly moving after the manner called for by the theory of sunlight pressure. The absorption of light by a free gaseous molecule is selective. Only a few rays of special wave-lengths are absorbed. Nevertheless, though only a fraction of the sunlight is effective, the mass to be moved is so small that a large velocity can be generated. And so far as one can see, this motion of repulsion under pressure of light from the sun must continue until the far away sun is only a star among the heavenly host, and its particular light-pressure is annulled by that of other stars, and comparative quiescence results under the influence of the general stellar complex

The Potash Famine

(*Concluded from page* 140)

What will be the economic effect upon the states of our Atlantic seaboard during 1916, as the wonted potash ration is lacking for their cotton, corn, potato, and tobacco fields, for the intensive culture of their thousands of truck gardens? Farmers and gardeners will furnish the customary supplies of combined nitrogen and phosphates, as they plow, and seed, and till They will perform the same amount of labor pay the same amount of taxes or the same rental yet, every intelligent southern planter knows that when he formerly harvested 10 bales of cotton, he may this year have but 8 bales as a return for his labors, where he usually gathered 23 bushels of beans per acre, he will now gain but 14 bushels where he ordinarily harvested 75 bushels of corn per acre, he can now hope for but 32 bushels.

It would not be a complicated problem in mathematics to calculate roughly what will be the economic loss during the present year, in any given state, such as Florida or South Carolina, resultant upon the absence of the normal potash ration.

We are now taking stock in many branches of the nation's industrial activity On every side the dominant notes are "Emancipation from Dependence Upon Foreign Products!" "Creation of Self Contained, Comprehensive, American Industries!" "Utilization of Our Natural Resources!"

What is the bearing of this newly awakened spirit of industrial independence upon the potash situation? Is there a possibility of temporary relief? Is there a prospect of permanent freedom from dependence upon Transatlantic sources?

To answer these questions intelligently we must know the nature of the part supply of potash salts. We must further consider to what extent such salts are present in the mineral wealth of our land Finally, we must note the steps requisite for their economic utilization.

Sources of Potash

Hitherto our domestic supply of potash compounds has come almost exclusively from Germany, directly or indirectly There was a small import of saltpeter from India, and of carbonate of potash from Siberia, Turkey, and several European countries. Otherwise, in common with the rest of the civilized world, we depended upon the famous mines of Stassfurt in Germany

It was about 1860 that the importance of potash in agriculture became generally known, thanks to the investigations and to the brilliant pleading of Liebig. The old-time source of potash, the ash heap of the pioneer, and of the inhabitant of richly forested regions, was then disappearing. A few years before, the marvelous deposits of various potash salts in the Harz Mountains [illegible] They [illegible]

by ordinary mine shafts, having a depth of from 1,200 to 2,800 feet.

The crude material, mined by customary methods, and brought to the surface, is refined by processes of leaching and crystallization, not unlike those employed in concentrating Chile saltpeter, in the land of its occurrence. Various well known commercial grades, consisting of chloride or sulphate of potash, or mixtures of the two, with variable amounts of magnesium salts, and containing from 20 to 62 per cent of actual potash, K_2O, are thus prepared.

The mining and purification of these potash salts of Stassfurt, begun in 1861, has become a great national industry. There are now 115 mines. The operating companies are closely united in a combination for selling purposes, which has a control bureau and 510 officers. The mines themselves give occupation to 2,200 officers and 35,000 laborers. The average daily output of crude salts is about 40,400 short tons. The annual output in 1911 was 10,700,000 short tons. About 40 per cent was used directly for fertilizing purposes, chiefly in Germany. The remainder was submitted to refining processes.

The transportation of the general share of this great output, purchased by the United States, would require the services of about 260 steamers of 4,000 tons each. The fleet is now lying idle, and there is a potash famine in our country.

American Sources of Potash

Let us take an inventory of our domestic resources.

First, there is a vast amount of potash in the refuse from the harvested crops. On an average, 80 pounds are removed annually to each acre under cultivation. Some part of this is found in the grain, tubers, lint, etc., which leave a farm. A much larger part is contained in the straw, stalks, hay, vines, etc., which are apt to remain on a farm, and be consumed by domestic animals. Thus a bale of cotton (500 pounds) contains 2 pounds of potash. The cotton seed, separated from it, contains 12 pounds. The 2,000 pounds of stalks, on which it grew, contain 37 pounds. Again, 20 bushels of wheat contain 6 pounds of potash. The 1,500 pounds of straw, accompanying it, contain 17 pounds. The dried excreta of domestic animals, fed on these crop residues, contain 2.25 per cent of potash. It is evident that by a rigid practice of feeding all crop residues to animals, and carefully conserving the manure, or else by incorporating the residues in the soil, a notable saving can be effected. Tobacco stems from Kentucky contain 8 per cent of potash—an extreme instance.

Wood ashes are in some sections still abundant. Hard wood ashes contain from 18 to 46 per cent of potash. The ashes of conifers contain from 14 to 20 per cent. There is an opportunity for widespread care in avoiding waste in this connection.

The potash of the cane and of the beet root is largely concentrated in the molasses of the sugar refineries. Some 26 distilleries make use of this molasses. The daily loss of potash in their waste is 106 tons. Methods have been recently devised to rescue this amount in a form available for use as a fertilizer.

There are several sources of the alkali among non-cultivated growth. Thus pine straw contains from 0.21 to 0.41 per cent of potash. Marsh grass contains from 0.84 to 2.89 per cent.

The most important of these plant sources, provided by nature, is found in seaweed. The marine growths of the Pacific are much richer in potash than those of the Atlantic. Along our Pacific littoral, including the coast and islands of Alaska, an annual crop of kelp awaits harvesting, containing potash valued at $90,000,000. No plowing, or seeding, or cultivation is required. The bountiful gift of Nature awaits the harvester. Dried and ground, it presents a fertilizer containing, on an average, 19 per cent of pure potash. It can be cut, collected, dried, ground, and transported to South Atlantic ports, at a cost per ton several dollars below the ante bellum rate for Stassfurt salts, equally rich in potash. When used in this form there is sufficient combined nitrogen

present to increase the value of the annual crop by $60,000,000

Turning now to mineral sources, we find several lakes in California containing such large amounts of potash, that it is quite feasible to use their brine and sediment as materials for the extraction of potassium sulphate and other salts of the metal

A much more important source is in the alunite of Utah, Colorado, and Nevada The mineral, a double sulphate of potash and alumina is roasted in order to drive off the sulphur trioxide combined with the alumina From the residue, potassium sulphate is easily extracted by water, and the resultant solution is evaporated to dryness The deposits at Marysvale, Utah, are ample enough to supply all of the potash required by this country for a century to come The exploitation of these deposits, on a fairly large scale, has already begun

The many veins of feldspar, with potash content ranging sometimes as high as 15 per cent, constitute a vast reserve of the alkali, awaiting an economical process of extraction Quite a group of chemists are actively engaged upon the problem Chemically it has been solved Capital is still hesitant about investing heavily in any of the dozen promising methods, worked out on a scale beyond simple laboratory experimentation

Can We Have an Independent American Potash Industry?

At present the prices for German potash salts in our trade centers are purely nominal Rates per ton of $400 to $500 are quoted, but there is practically no stock of the salts available The price for the most common form the muriate or chloride, containing 80 per cent of the pure salt (equivalent to 52 7 per cent of K_2O), was $38, per long ton in July 1914

There seems to be no question but that potash, especially in the form of a fertilizer, can be easily supplied from American sources in competition with this rate

Despite the urgent appeals of consumers of potash compounds, especially in the arts, for supplies at almost any price, there is evidently much delay about taking vigorous, energetic measures to build up a genuine national industry A certain amount of activity is in evidence in the working on a systematic basis, of the alunite deposits of Utah Small quantities are regularly obtained at Owens Lake, California. There are also, a number of efforts on a very small scale in Southern California, and about Seattle to build up the kelp industry And yet it all is so sadly out of proportion to the nation's needs!

There are several marked difficulties in the way of a healthful evolution of the American industry

The alunite industry of Utah struggles with the handicap of heavy freight rates across the continent.

The kelp industry of the Pacific Coast is restricted by the lack of legislation, clearly defining ownership in the floating harvest within the 3 mile limit, and safeguarding the establishment of the requisite plant to gather, dry, and market the valuable crop

In addition to these very pronounced obstacles, there is the inevitable dread, if not certainty that no matter what rates may be fixed for the sale of American potash in our domestic market the foreign competitor, on the return of normal international exchanges, will deliberately and persistently reduce the selling prices of the Stassfurt products when brought to our ports so as to completely throttle any attempt at disputing the hitherto dominating factor in the situation

There is, therefore, room for enlightened and farsighted legislation, state and federal, to remove absolutely the obstacles in the way of the domestic exploitation of our unlimited potash resources.

There would seem to be, also, a manifest opportunity for intelligent, patriotic controllers of capital, to promptly and decisively settle, on an adequate scale, all questions regarding the cost of production of potash compounds from the different sources enumerated above. There seems to be little doubt but that the dried kelp of the Pacific will eventually be our cheapest form of potash fertilizer. It is a moot question from what source we can most economically secure the technically pure potassium salts required in the arts.

Side by side with a genuinely American solution of the complex dyestuff problem, should stand an equally national solution of the potash problem.

The hardships, incident to the present famine, must be promptly alleviated The economic fabric of American industrial life must never again be exposed to such loss, such dislocation, through dependence upon a foreign source for the nation's potash supply!

Naval Militia and Preparedness

(Concluded from page 139)

tended to promote good fellowship within the unit and between the various units Entertainments, dances, smokers, athletic events and other diversions are encouraged with this end in view

Each division of the Naval Militia must fulfill certain specified requirements imposed both by the various states and by the Navy Department before it is granted recognition In the first place, comes the minimum number of officers and enlisted men, next comes the performance of the required percentage of drill duty, and then the qualification of a specified percentage with small arms—rifles and pistols, next, the qualification of two crews from each division on the secondary battery—6-inch and under—and, finally, a specified percentage of performance on ordered duty such as battalion reviews and musters and on the annual Federal cruise aboard a battleship

The regular drill season begins on the first Monday of each November and ends on the last Saturday of May Under ordinary circumstances there is one battalion drill during each month. The battleship cruise lasts fifteen days. During the summer, small week end cruises are made on the vessels allotted to the various states by the Navy Department These cruises are voluntary on the part of the men and, although regular discipline and routine are maintained, they are very enjoyable trips.

It is only fair to assume that the average American citizen is patriotic As he is recognized to be intelligent, it is to be assumed also that he has drawn conclusions from the examples furnished by the war raging at present in Europe, and such conclusions must point to the fact that some move should be made by the United States toward preparedness not *for* war, but *against* war Now, as a suggestion to the normal American Why is it necessary to wait for Congress to mull over the situation and finally settle it with an eye on the internal political result? Let each patriotic man prepare himself to the best of his ability to serve his country in the manner that will make his services most valuable to his country If he has a profession, let him place himself at the disposal of the nearest National Guard or Naval Militia organization having use for his particular profession in order that his knowledge and experience may be utilized in the training and instructing of others, while he himself is being trained If he has a trade, let him enlist in the organization making use of that trade, so that his services may be given the maximum value with the minimum amount of training If each American does his part in this manner, Congress will be relieved of much of the trouble it is apparently finding, and adequate preparedness will be the result.

New Developments in Military Aeroplanes

(Concluded from page 147)

In addition to this standard type there has been developed in Germany another type of aeroplane-destroyer which, however, is only placed into the hands of a few very skillful pilots. This machine, of which much has been heard lately, is the Fokker monoplane. In general appearance, as well as for its armament the Fokker is a very close copy of the Morane destroyer—even to the extent of its engine, which on the standard type is a 100 horse-power Oberursel-Gnome,

the German copy of the Gnome rotary. There is also a higher powered model fitted with a 160 horse-power Mercédès engine which furnishes a speed of more than 100 miles per hour Just like the Morane, the Fokker's machine gun fires through the armored blades of the air-screw; and just like its French antagonist, the Fokker embodies climbing ability and "controlled instability," *i e*, quick responsiveness to the controls, to the highest degree. This is why only exceedingly capable airmen are able to handle it.

According to recent press accounts of this new German aircraft, the favorite method of attack is for a Fokker to get up high, to about 1,500 feet or so, and fly about until one of the Allies' machines appears in sight below Then, if of the fixed gun type, the Fokker stands on its head and dives straight for its victim, loosing off a stream of bullets as soon as it gets within range By making the descent ever so slightly spiral, the straight stream of bullets becomes a cone of fire, with its apex at the gun, and with the victim inside, so that whichever way the lower machine tries to escape it must pass through that cone When the Fokker gets close to the enemy, if he be not already hit, it approaches directly from behind, firing straight along the body or fuselage, so as to have pilot, passenger, tanks, and engine all in one line of fire, and unless the pursued machine is very quick on its controls and is able to dodge like a rabbit some vital part is bound to be hit sooner or later

Fokkers which do not fire through the propellers almost always attack their victims from behind, diving under their tails and coming up in such a position that, while they can shoot up into the body of the pursued machine, the passenger in that machine even if sitting behind the pilot, cannot shoot at the Fokker for fear of blowing his own tail off

The Fokkers have scored notable success on the Western front by destroying 16 British aeroplanes within a month but they have been much less successful against the *avions-canon* and the aeroplane destroyers of the French. Thus on January 10 an aerial battle was fought above Dixmude between three Fokkers and three *avions canon*, which resulted in two of the Fokkers being shelled to pieces, while one *avion canon* was forced to land on account of a pierced petrol tank

On their part the British have just placed in commission a limited number of novel aeroplane destroyers which have proven a good match for the Fokkers Thus on January 17th a British airman attacked three Fokkers single handed and forced them to land On the same day three more Fokkers were put to flight by British pilots

After all that has been said it must not be forgotten that the Fokker—just like the Morane—is more of a freak than a real fighting instrument, whereas, in order to furnish great speed and climbing ability, it has to carry a very light load, the Fokker's range is limited to a maximum of about two hours' flight. Therefore it cannot be employed for long range operations

The Germans realize this perfectly well, and that is why they are busily engaged in further developing a battle aeroplane of the type of the famous Arminius'

The latest reports from abroad state that the French government has cognizance of the existence of a huge German battle aeroplane that was tested with great secrecy on Lake Constance last November This new machine is propelled by two 225 h.p. and two 180 h p. engines, probably of the Mercédès make. This powerplant of over 700-horse-power is said to furnish a top speed of 110 miles per hour The armament consists of a battery of four Maxim guns and bomb throwers which are mounted on an iron clad nacelle. The normal crew consists of eight men. The machine is also equipped with a wireless outfit and a searchlight.

It is further known that the French government is conducting extensive ex-

periments with different types of multiple engined aeroplanes.

The first one of this type, the twin tractor Caudron biplane, which is fitted with two 80 h.p. Le Rhône engines, is already in commission. This machine carries a wireless outfit and is exclusively used for artillery observation. Its armament is entirely protective and consists of a machine gun mounted on the bow of the nacelle.

The latest aeroplanes, however, will be four-engined with the power plant ranging from 600 to 800 h.p. But the disclosure of further details seems inadvisable for the present.

NEW BOOKS, ETC.

NEURASTHENIA, OR, NERVOUS EXHAUSTION By J. H Kellogg, M D, LL.D Battle Creek, Michigan Good Health Publishing Co., 1915. 8vo, 389 pp., illustrated Price, $1

COLON HYGIENE. By J H Kellogg, M D, LL D Battle Creek Michigan Good Health Publishing Co, 1915 8vo., 893 pp., illustrated.

Dr Kellogg has given us in these engaging works so illuminating a survey of auto intoxication, and so sensible a regime for combating this alarming prevalent condition, that every sufferer should avail himself of the experienced aid here extended. In Neurasthenia" the reader is made acquainted with almost every available means of relief A noteworthy chapter is that on Habit, How Formed and Reformed", in this chapter that microscopic mechanism, the synapse, is explained in its relation to nerve action and habit formation In Dr Kellogg's second volume, "Colon Hygiene," the author takes a physiological survey of the field, treats of constipation and toxemia and, in his usual straightforward manner, details the modern methods of "natural" correction Posture diet, bathing exercise, massage, electricity all are considered in their remedial aspects. The problem of changing the intestinal flora is seriously discussed, and many practical suggestions are offered

PROJECTIVE ORNAMENT By Claude Bragdon, Rochester, N Y The Manas Press, 1915 8vo., 79 pp., illustrated Price, $1 50

We have, Mr Bragdon thinks, urgent need of a new form language, and this he seeks to discover in four dimensional geometry His substitution of angles for curves in ornamental iron work and the extreme closeness of his design, will hardly be accepted by modern eyes as pleasing, his mural patterns are so enormous as to dwarf into insignificance the human figure, and it is noteworthy that most of his settings require the Greek costume, modern dress would at once accentuate the fact that accepted modes could never blend with such ornamentation Perhaps the chief criticism of his four-dimensional method is that while the spur to originality that, in the brain of some means employed may be new, the resultant symbols or approximate forms have been used for ages. Yet the suggestion of the volume is interesting, and may conceivably serve as a genius may flower into happy results. What the world most needs, however, is a return to the old purity of principle this alone can assure designs of taste and distinction.

A VOYAGE IN SPACE. By H H Turner, D Sc, D C L., F R S. London Society for Promoting Christian Knowledge 1915. 8vo, 304 pp, 180 illustrations. Price, 6s. net.

Every year, at Christmas time, the Royal Institution has a course of children's lectures, when some well known teacher or scientist graphically sets before his excited audience the most interesting facts and experiments. In 1913 our author, who is Savilian Professor of Astronomy in the University of Oxford, delivered these lectures and here we have them substantially as they were taken down in shorthand. In this fascinating voyage through space, our navigator points out the leading figures and discoveries in astronomical history. The work will edify and stimulate any thoughtful boy or girl Two children have themselves taken a hand in the illustration of the volume, and the result, while it does not reveal any wonderful mastery of technique, speaks eloquently for the inventiveness and imagery of the child mind.

THE TELEPHONE AND TELEPHONE EXCHANGES Their Invention and Development By J E. Kingsbury, M I E.E. New York Longmans, Green and Co, 1915. 8vo, 558 pp., illustrated. Price, $4 net.

Mr Kingsbury modestly refrains from regarding his volume as a full-fledged history of telephony It would be injustice on our part, however, to deny him the word. The work is indeed not exhaustive, but the selections and summaries have been so wisely undertaken that the general effect is that of comprehensiveness. The author's method has been to select the principal inventions of both the initiatory and development periods of telephony; but, as he remarks, "technical, commercial, and political threads compose the fabric, and they are thus woven in the record." By the narration of prior causes, technical features become [illegible] understandable. Under the caption, "[illegible] [illegible] survey of the early practice; [illegible] are [illegible] [illegible] office [illegible] The chapters on "[illegible]" and "The [illegible] of the Telephone" noticeably contribute to the value of the work, which is on the whole an excellently balanced discussion in which all inventors are given a free field and no favor.

AUTOMOBILE REPAIRING MADE EASY. By Victor Pagé, M.E. New York: The Norman W Henley Publishing Company, 1916. 8vo.; 1060 pp.; 1000 specially made engravings. Price, $3 net

In an exposition much more thorough than that of the handbooks usually found upon this subject, the author gives the motorist and repair man the most approved methods of car restoration. The workshop is planned and equipped, and overhauling and repairing in all their branches are simply explained. This instruction relates not only to the engine and its accessories, but also the chassis and its furnishings. The mechanic will find numerous tables, short cuts in figuring, and rules of practice Valve and magneto timing, "tuning" the engine, trouble location, and electric starting and lighting are all included As a work of ready reference this should prove alike valuable to the amateur tinkerer and the experienced workman Its exhaustive index means the satisfaction of knowing that any desired information may be tapped without a long and wearisome search

ARITHMETIC OF ELECTRICITY By T O'Conor Sloane A.M., E.M, Ph.D. New York The Norman W. Henley Publishing Company, 1916. 12mo., 160 pp. Price, $1

The twenty first edition of this popular treatise reduces electrical calculations of all kinds to a series of simple rules which deal only in the terms of common arithmetic. Practical problems and detailed solutions follow each rule The work will continue to make a strong appeal to students of electricity who are unfamiliar with algebraical methods.

DINOSAURS. With Special Reference to the American Museum Collections. By W D Matthew, Curator of Vertebrate Palaeontology New York American Museum of Natural History, 1915

'Dinosaurs is a monograph in paper covers which reprints from the American Museum Journal and other sources many popular descriptions by authorities These are so combined and supplemented as to make a coherent report of the collections in the Museum. The first discoveries of dinosaurs in the Western formations are narrated by Prof Williston of Chicago University There are many good photographs of specimens, and restorations are offered by a competent artist working under the supervision of Prof Osborn Field experiences form a most interesting part of the treatise and there is a brief guide to the literature of the subject.

MINERALS AND ROCKS. By William Shirley Bayley, Ph D Professor of Geology in the University of Illinois. New York D Appleton and Company 1915 8vo, 227 pp., illustrated. Price, $2 net

Students of geology who desire to familiarize themselves with the material of the earth's crust without venturing upon extended courses in mineralogy and lithology will find a useful companion in this short, descriptive laboratory guide Only the most important minerals are chosen and just sufficient description is given for the identification of each Within the somewhat narrow limits of its scope, the volume carries out its promise in a well arranged and helpful text.

SAFETY IN THE FOUNDRY. By Magnus W Alexander, of The General Electric Co., Chairman Committee on Safety and Sanitation of the National Founders' Association. Chicago, Ill. National Founders' Association, 1915. 8vo, 187 pp., illustrated

In this work is incorporated the findings of the Committee on Safety and Sanitation appointed by the National Founders' Association. This material is brought down to date, and is augmented by chapters from other sources and by hitherto unpublished illustrations. The foundry yards and floors, with all their machinery and implements, are subjected to a close scrutiny, and the most approved safety methods and devices are placed at the disposal of the reader. There is also a chapter on the physical examination of employes—a commendable addition, since bodily fitness constitutes an even greater assurance of safety than a painted warning sign or a wire screen guard. Foundry managers will find that the work reflects the mature experience of the practical foundryman and executive

EXPERIMENTAL PHYSICS. A Text-Book of Mechanics, Heat, Sound and Light. By Harold A. Wilson, M.A., D.Sc., F.R.S. New York: G. P. Putnam's Sons, 1915. 8vo.; 400 pp.; illustrated.

Prof. Wilson, formerly Fellow of Trinity College, Cambridge, and now [illegible] of Physics in the Rice Institute, [illegible] has compiled [illegible]

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14083) W E. H. asks Will you kindly state in your paper the scientific explanation of the reason why a tin can, whose specific gravity is between 7 and 8 will float In order to float it must displace a volume of water whose weight equals its own weight but why does it displace this amount? 2 Is there any unit for momentum in the English system? Is it merely a comparative quantity? A 1 A tin can containing only air weighs much less than the same volume of water weighs If the can holds a quart of water, the volume of water will weigh about two pounds, while the iron can will weigh perhaps 4 ounces If such a closed can is put into a basin of water its weight, 4 ounces will push down into the water till it has pushed 4 ounces of water to one side It then rides upon the water The water pushes it up or bears its weight, and it floats for the same reason that a board floats or a man floats. It weighs less than the same volume of water weighs. You ask why does a floating body displace a weight of water equal to its own weight. We have answered it by saying that the body pushes water aside as it settles into water till it has pushed with its whole weight down into the water If its weight is less than that of the equal volume of water, then it floats. If its weight is greater than that of the equal volume of water it can push on after its own volume of water has been pushed aside and go on to the bottom 2 A unit of momentum can be made in the English measures just as it is in the metric measure by using a unit of mass and of velocity It is not necessary Why not consider momentum as the kinetic energy of the body?

(14034) W F S writes Answering your criticism (13077), regarding my computation that cast iron will float at a depth of 33 7 miles, I am well aware that compressibility of water diminishes with increase in pressure but we do not know what occurs after some 90,000 pounds per sq inch has been passed

A manufacturer of high pressure hydraulic machinery ran some tests a few years ago in which pressures up to 90 000 pounds per sq inch were used The results of his tests may be found in the proceedings of The American Society of Mechanical Engineers However, I do not think he paid much attention to the compressibility of water, except that he noticed it decreased in volume considerably In my computations I figured in the usual way, as is done with steel and iron in metal structures, that strain and compressibility are directly proportional to the stress

Professor Goodman gives the following constants as values for the coefficient of elasticity of volume

Water	140
Cast Iron	6 000
Wrought Iron	8 800
Steel	11,000
Brass	6 400
Copper	10 500
Flint Glass	2 400

Thus on this basis, steel would sink deepest wrought iron next, and cast iron next

This same author gives the following as the weight of materials as commonly used in engineering practice

Cast Iron	0 26 lb per cu in.
Wrought Iron	0 278
Steel	0 283

I therefore cannot understand why or how you can contend that I am wrong when I say that cast iron is lighter than steel It is considerably lighter even according to the figures which you publish namely

White cast	7 58 to 7 71	sp gravities
Gray Cast	7 03 to 7 13	
Steel	7 60 to 7 80	

Whether water has a "crushing strength" or not I do not know Maybe it has. If so, it is reasonable to assume that at, say, 200,000 pounds per sq inch water crushes and diminishes very rapidly in volume This is true in the case of some solids such as cotton Cotton is now used for making gears for use in machinery It compresses rapidly at first as we all know, but on hardening the compression grows less and less just as in the case of water Finally though, a crushing strength is reached where the fibres give way and then it is natural to suppose that the volume decreases more rapidly again. The manufacturers of these gears are careful to keep the compression within the safety limit.

I do not claim that 33.7 miles is the "correct" depth at which cast iron will float, but, so far as I know, it is the only figure that has been arrived at as the "probable depth," using our ordinary structural or engineering formulas and a method that is at least fairly rational.

I can see no reason why water may not be compressed until it becomes heavier than

cast [illegible] or steel, even at the rate of [illegible] of volume as published in the SCIENTIFIC AMERICAN. It is an interesting [illegible]

We publish in full the reply of our [illegible] correspondent, leaving the matter with our readers. We can see no reason from the physical constitution of water to suppose that it can ever become more than 7 [illegible] denser than it has ever been made by compression. Nor can we endorse the opinion held by our correspondent that water can have a "crushing strength" Still these are only opinions, and we may agree to differ cordially upon the matter. Neither can prove the other wrong.

(14035) V. L. S. asks Given the magnifying power and focal length of a telescope and the actual distance of a given object, is there a formula by which to compute the apparent distance of the object as viewed through the lens? If so, what is it? A The apparent distance of an object as seen through a telescope is found by dividing the actual distance by the magnifying power of the telescope Thus the moon, whose actual distance is about 240,000 miles, with a magnifying power of 600, is brought to an apparent distance of 400 miles and is seen as it would appear at that distance.

(14036) A. C asks Do you know of a formula for a photographic gelatine printing out emulsion, or can you refer me to some literature dealing with photographic gelatine-emulsions? A You will find formulas for all the various photographic processes, including printing out papers, in our Cyclopedia of Formulas, which we send for $5 00 by mail post paid The book contains 15 000 formulas covering every field of work and interest. For a description and table of its contents, see circular

(14037) R. B B. writes: Under the head of Notes and Queries, No 13988 in the issue for Oct. 2, referring to the mode of placing a switch on a board, you say The usual and best practice is to have the current enter at the top so that the *blades* will be alive and the *jaws* dead when the switch is open This is because the blades present more surface and reach out farther than the jaws, so that there is more risk of accident with the blades alive ' Evidently you have the underlined words, *blades* and *jaws* interchanged, which gives just the opposite meaning to that which is intended as explained in the following sentence A. The accidental exchange of the words blades" and ' jaws ' in the answer to query to which you call our attention is obvious. The last sentence is correct, and contradicts the preceding statement. We thank you for calling attention to it.

(14038) E P S. asks In a lecture in the lyceum course at Dinuba, Cal, last winter a lecturer illustrating the phenomena of the gyroscope declared that there is no known explanation of the gyroscopic resistance, and that there is waiting a very large prize for the fortunate discoverer etc Will you kindly inform me if it is true that there has been no explanation of the resistance of the gyroscope to the side pressure? If so, is it a fact that there is a prize for the discovery of same? A We can furnish you with two books upon the Gyroscope, which seem to us to cover the theory of the action of this instrument very well They are Crabtree's Spinning Tops and Gyroscopic Action price $3 25 and Cordeiro's Gyroscope price $1 50 You should read both books. We are not aware of any prize for a theory of the gyroscope The theory is mathematical and has been quite fully worked out.

(14039) P C asks Will you be so kind as to give me a little information in regards to the magnet on a common magneto used for automobile ignition? Will you kindly inform me how to re-charge the magnet, either by direct or alternating current, so as to put the magneto in good order? A A magnet cannot be charged by an alternating current of electricity A direct current is necessary for this purpose. The central station of the lighting service in your place may have the means for re-charging magnets. If so the best way is to get it done there If this is not possible, a battery of six or more cells with a strong electromagnet will do the work The electromagnet should be U-shaped for best results. Place the poles of the magnet to be charged in contact with the poles of the electromagnet, and turn the current on and off for a minute or so. If you wish a certain pole to be positive, you must place this pole in contact with the negative pole of the electromagnet Usually in a magneto it does not matter which pole is plus, only all the poles of the same name must be turned in the same direction If the electromagnet is straight and not U-shaped, draw one pole of the magnet to be charged across one pole of the electromagnet, and the other pole across the opposite pole some ten times each, and the magnet will be charged.

(14040) J W P asks I am interested in the making of dry batteries, and would like to get hold of a process to make dry batteries which will give a good current, and which at the same time would not readily deteriorate. Could a dry battery be made which would have the lasting qualities of a gravity battery, do you think; and where could I find a formula for the filling of the battery? If any such has been published in the SCIENTIFIC AMERICAN, kindly give me the date of same, and oblige. A. A formula for filling dry cells which we consider a good one is given in the SCI [illegible] Vol. 113, No. 7, page [illegible], which we will send for ten cents. We [illegible] that [illegible] dry cell shall be [illegible]

[illegible]

(14041) [illegible] asks [illegible] nature of the arc employed in [illegible] high frequency oscillations for the [illegible] telephone [illegible] between Arlington, Va., and San Francisco, Cal.? A Thus far the telephone company which undertook the [illegible] has not divulged any technical details concerning the apparatus used in the record-breaking radio telephone transmission. However, it is generally understood that no arc was used but instead there were employed some 500 vacuum high-frequency generator tubes connected to a 250-volt direct-current circuit. The primary energy was 300 kw., while the total energy transformed into high frequency current and delivered into the antenna was about 70 kw at 150 amperes.

(14042) F J G. asks: Does a person have to secure a government license to operate a receiving set? What are the laws applying to receiving messages? A. A person does not have to take out a license for operating a receiving set only However, while all messages may be received a person is not permitted to divulge to any one else the contents of messages intended particularly for another person For instance: There are stations sending out press matter to ships at sea equipped with apparatus of the company controlling the station The press messages are preceded by a statement to the effect that the press matter to follow is intended for ships equipped with certain apparatus. Accordingly, while any one can receive this press matter, they are not allowed to divulge it since that would be taking advantage of a service that has not been paid for The justice of such legislation is evident.

(14043) D W W asks Would it be satisfactory to employ a lightning arrester of the type used in telegraph and telephone work for protecting a wireless station against lightning? A No; such a lightning arrester would not be satisfactory since if it were permanently connected to the aerial the current from the transmitter would jump through the arrester to the ground and thus expend itself without covering the transmitting range desired. There is only one approved method of protecting a station against lightning and that consists of entirely disconnecting the apparatus from the aerial and then grounding the aerial through a heavy switch and ground lead The switch had better be one of at least 100 amperes capacity and designed for 250 volts. It can be of the single-pole double-throw type so that when thrown in one position it connects the aerial to the station apparatus, while in the other position it connects the aerial directly to the ground The ground lead should be at least a No. 4 copper wire or a plurality of copper wires of a total carrying capacity equivalent to a single No 4 wire This wire should run as straight as possible, entirely outdoors, and devoid of any sharp turns The ground connection should be as good as is obtainable When a system of this kind is employed, the aerial should be grounded upon the approach of an electrical storm In fact, it should be grounded at all times when the station is not in operation Not only does this method offer the best protection known against lightning, but it also meets with the approval of the Fire Underwriters.

(14044) W R D asks What does the law specify in regard to the wave length of commercial stations? A The law is so simple to understand in this case that it may be quoted verbatim ' First Every station shall be required to designate a certain definite wave length as the normal sending and receiving wave length of the station This wave length shall not exceed six hundred meters or it shall exceed one thousand six hundred meters (The wave lengths between these two limits are reserved for government stations) Every coastal station open to general public service shall at all times be ready to receive messages of such wave lengths as are required by the Berlin convention Every ship station and every coast station open to general public service shall be prepared to use two sending wave lengths, one of three hundred meters and one of six hundred meters, as required by the international convention in force Provided, That the Secretary of Commerce may, in his discretion, change the limit of wave length reservation made by regulations first and second to accord with any international agreement to which the United States is a party Second In addition to the normal sending wave length of all stations, except as provided hereinafter in these regulations, a station may use other sending wave lengths Provided, That they do not exceed six hundred meters or that they do exceed one thousand six hundred meters Provided further, That the character of the waves emitted conforms to the requirements of regulations third and fourth following. Third. At all stations if the sending apparatus, to be referred to hereinafter as the "transmitter," is of such a character that the energy is [illegible] in two or more wave lengths, more or less sharply defined, as indicated by a [illegible] wave meter, the energy in no one of the lesser waves shall exceed ten per centum of that in the greatest. Fourth. At all stations [illegible] per complete [illegible] by the [illegible] exceed [illegible], except [illegible] or signals and [illegible]

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV
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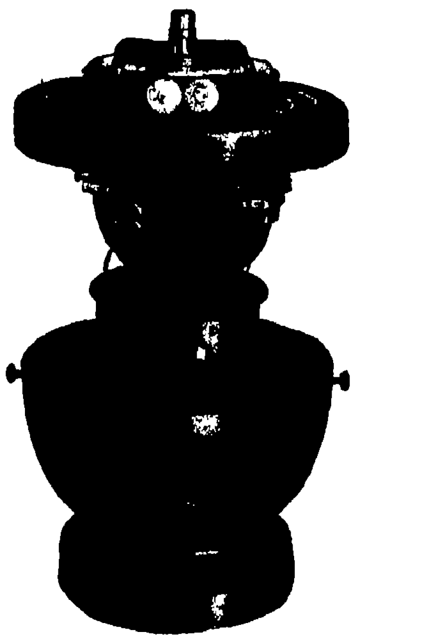
Gyroscope of the type employed for the installation aboard the U. S destroyer "Worden"

Installation on board an aeroplane of the Sperry stabilizer and kindred devices



Sperry gyroscopic master compass with lower part binnacle down to show mechanism

The Seventh Award of the Scientific American Medal for Safety Devices

By Dr William H. Tolman, Director American Museum of Safety

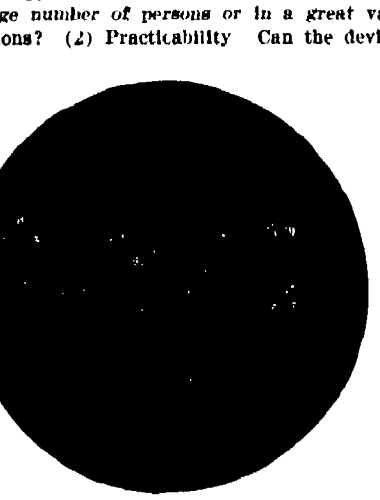
EIGHT years ago the American Museum of Safety was formed by a small group of men interested in safeguarding life and limb from industrial and other accidents For the greater part, the trustees were editors of technical publications, which supported the new movement with great enthusiasm That the work of the museum has been eminently successful is evidenced by the fact that to-day there are several Museums of Safety throughout the United States Furthermore, the great number of "Safety First" societies, committees and other organizations, which have for their object the elimination of carelessness and faulty equipment as a means of preventing accident, may be said to be a direct result of the inspiration received from the work of the American Museum of Safety

Early in the history of the museum it was felt that some encouragement should be offered to corporations and individuals to invent and install safety devices as well as to look after the welfare of employees The Scientific American was the first to offer a medal for this purpose, and it has now been awarded seven times for the most efficient device invented within three years of the award and exhibited at the museum In the Scientific American of February 7th, 1914 the first five winning devices were illustrated and described These are as follows 1908.—The Rich Marine Fire Extinguisher Company, 1909—The Patent Scaffolding Company, 1910—The Norton Company, 1912—The Draeger Oxygen Equipment Company, for the Pulmotor, 1913—The Welin Marine Equipment Company The sixth award, made to the Shurloc Elevator Safety Company, Inc., was described in the February 20th, 1915, issue of the Scientific American

The annual meeting and banquet of the American Museum of Safety took place on February 3rd, 1916, at the Waldorf Astoria Hotel, New York City, and was attended by many distinguished guests. Mr Arthur Williams, President of the American Museum of Safety, presided at the banquet. The speakers were the Hon. George B. Cortelyou, Mr Elmer A. Sperry, the Scientific American Medalist, Hon. Henry W Hodge, Member of the New York Public Service Commission, and Mr William Armstrong Fairburn, President of the Diamond Match Company

The Scientific American Medal was awarded to Elmer A. Sperry and the Sperry Gyroscope Company for notable achievement in securing safety in marine and aerial navigation. Professor Frederick Remsen Hutton, Sc D, Vice-President of the Museum, in presenting the medal said, in part "By the authority of the sovereign State of New York conferred for this purpose upon the American Museum of Safety, and by direction of its Board of Trustees and in its name and behalf this medal is now conferred upon you for distinguished achievement in securing safety in the department of productive industry in which you have won your fame"

The general principles on the basis of which the Museum recognizes successful achievement are as follows (1) Applicability Does the device secure safety *for a large number of persons or in a great variety of conditions?* (2) Practicability Can the device be



Scientific American Medal for safety devices, awarded to Elmer A Sperry

used economically and successfully? *It must not be too cumbrous or intricate to apply or operate* (3) Simplicity It must not be so complicated that experts are required to handle or keep it in repair (4) Reliability It must not be liable to derangement or failure to work in emergencies. (5) Durability It must not be so delicate or need such fine adjustment that it will not stand up in service. (6) Commercial availability *It must not be too expensive to install* or maintain in operation, it must be obtainable in an open market for the use of all

The remarkable work of Mr Elmer A Sperry, in the application of the gyroscope to many purposes, has been of such an interesting and unique nature that his inventions have been often described in the technical press. Not the least interesting of these is the gyroscopic stabilizer for use on ships ranging from a launch to the mightiest of steamers Unfortunately, space does not permit of a description of the gyroscopic stabilizer as applied to vessels for the purpose not only *of preventing the usual rolling caused by roughness* of the water, but also for the reversal of this operation, namely the rolling of vessels intentionally as an aid to forcing a way through an ice field In the Scientific American of December 18th, 1915, there appears a description of the gyroscope as a ship stabilizer, with special reference to the tests on the yacht "Widgeon" which were highly successful In the *Scientific American Supplement of* March 29th, 1913, there appears a more detailed description of the Sperry gyroscopic stabilizer for ships In connection with the stabilizer, Mr Sperry has also devised a gyroscopic mechanism for recording the roll and pitch of vessels at sea, which was described in the Scientific American of August 23rd, 1913 A similar apparatus known as the Pallograph was described in the issue *of January 8th, 1910 The Sperry gyroscopic aeroplane* stabilizer and its numerous companion inventions was described in the issues of June 7th, 1913 and August 8th 1914, respectively In the Scientific American of June 29th, 1912 there appeared a detailed description of the Sperry gyroscopic compass which is widely employed to-day aboard war vessels, especially submarines Mr Sperry's inventions in a word, illustrate what can be done by *thoroughly mastering* the principles of such simple devices as the gyroscope and then applying them to a useful purpose.

At the annual meeting of the American Museum of Safety there were also awarded aside from the Scientific American Medal a number of others The Travelers' Insurance Company's Medal went to Mr Wilbur C Fisk and the Hudson & Manhattan Railroad Company for achievement in accident prevention among its personnel and for promoting safety for the traveling public The Louis Livingston Seaman Medal was awarded to Mr William A. Fairburn and the Diamond Match Company for the elimination of occupational disease in the match industry The E H Harriman Gold Medal was awarded to the Cincinnati, New Orleans & Texas Pacific Railroad which was considered as the American steam railroad which, during the year had been most successful in protecting the lives and health of its employees and the public The Anthony N Brady Gold Medal went to the Union Traction Company of Indiana, which was recognized as the American electric railway company which, for the year of the award had done most to conserve the safety and health of the public and its employees.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Significance of Science

THERE are quite a large number of people in the world who are never tired of attacking science and the scientific way of looking at things, and the existence of the great war in Europe has given them a greater boldness and prominence than ever before. And also it must be admitted it has given them a greater apparent justification. Science, they assert, has piled up knowledge without in any way affecting the baser elements of human nature. The fruits of science are all about us in the forms of electric street cars, railways, telephones, submarine cables and a thousand other conveniences, yet a cursory examination of any newspaper will convince us that the old vices of man kind flourish as strongly as ever, and to crown it all, we are living in a time when the greatest slaughter in the history of the world is taking place. It would appear that the only change science has wrought is a change in the material conditions of mankind. It must be confessed that there is much to be said for this point of view, and yet can it be true that the pure disinterested search after knowledge which has inspired men to live laborious days and to die, in some cases, shameful deaths, is to have no other result than to add to our bodily comforts or to increase the murderous power of our engines of destruction? One cannot rest content with this conclusion, and indeed, there is no reason to do so. Science has a spiritual side, but in order to see it, it is necessary to make a distinction between science and its applications.

The true aim of science, expressed in a word, is to increase the self-consciousness of man. We have emerged from lowly forms of life where self-consciousness is almost, if not quite, non-existent. Each advance has been in the direction of the acquisition of a greater degree of self-consciousness. Long ages ago man commenced to distinguish himself from the trees and stones about him. He began to form a picture of his universe and of himself as related to that universe. His consciousness grew; he distinguished between one tribe and another, between one family and another, between one individual and another. When Copernicus propounded his theory that the earth revolves about the sun he altered at one blow, man's conception of the relation between himself and the universe. Man saw himself more clearly; he was no longer the miraculously unique creature he had supposed himself to be. Darwin with his origin of species effected another great change in man's estimate of himself. Again man's self-consciousness, his conception of his relations to everything outside himself, acquired an extension and intensification. The main function of philosophy has been of the same kind and it is interesting to note that it is now thought that the true significance of art is to be found in the same direction.

With this extension of self-consciousness comes a fuller appreciation of the essential nature of man and of his possibilities. By discovering man's true relation to the universe we see also how he may best live in peace and harmony with that universe. Every scientific discovery, every discovery from whatever source which shows us more clearly what this world is in which we live, reacts upon man himself and causes a further adjustment of his relations to that world. Now the true argument against vice and against war is that these things are not in harmony with that further development of mankind which science has shown us to be a possibility. People may be found to argue that war is a benefit. They talk about "biological necessity"—they garble science. There may even be people who argue that vice is a benefit. But the whole trend of scientific thought is in the opposite direction. It is incorrect to say that science has no moral aspect. The mind of man is not divisible into water-tight compartments although writers of philosophical text-books sometimes find it convenient to assume this unnatural division, and science, philosophy and art, all have, and must necessarily have, a moral aspect. By showing us more clearly our own nature and the nature of the world about us they implicitly condemn certain activities and foster others.

If this aspect of science has been far less insisted on than its material applications it is due, in some measure, to the newness of the subject. The true significance of any great human departure is always the last thing we perceive about it; the obvious points are the ones we see first. Scientific men are every now and again delivering themselves of speeches with the object of justifying science. Usually they refer one to its applications. It has given us pasteurized milk, electric light—and 17-inch howitzers. It has given us the means of saving life and the means of destroying it. It is difficult to see exactly what this line of argument proves. But we are inclined to think that this kind of argumentation is largely beside the point. There is an old and familiar saying, "The truth shall make you free" free from the baser elements within ourselves. And it is because the spirit of science tends in this direction that science is most emphatically worth while. The body of science does, on occasion, assume strange forms, but its spirit has one fixed direction.

The Need of Trade Mark Treaties Between American Republics

IN these days when American Republics are drawing together in closer commercial relationship and our merchants are undertaking to develop a market for their products in Central and South American countries, it is well to draw attention to serious complications now existing in the protection of trade marks. A very able paper on this subject prepared by the Hon. J. T. Newton, Asst. Commissioner of Patents, was read recently before the Pan American Congress. The paper is of utmost importance to owners of trade marks and for this reason we are republishing it in full in this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

We are entirely in accord with the plea put forward by Mr. Newton for coöperation between the United States and other American states in the protection of trade marks and trade names. As Mr. Newton points out, in a number of cases trade marks which have become valuable through long and continued use in the United States, have been appropriated by unscrupulous people in other states and when the American manufacturer endeavored to import his merchandise with his trade mark into such states his goods were denied entry and in several cases were confiscated.

Mr. Newton draws attention to the lack of harmony between trade mark laws of various republics. Some of them differ very radically from others and this has caused great confusion. His article makes a strong plea for a treaty relationship between the United States and Central and South American countries for the purpose of enacting uniform trade mark legislation. In connection with such legislation he suggests that two bureaus be established, one in Havana, Cuba, and the other in Rio Janeiro, Brazil. These bureaus would have charge of the registration of trade marks of the various countries involved.

The Perennial Martians

ANOTHER opposition of Mars has taken place, and if history repeats itself the Sunday supplements should be telling us just what horse power is ordinarily required to operate a Martian pumping station, what kind of harvesting machinery the Martians use in gathering their crops, and how a self-confessed "scientist" in Podunk proposes to telegraph to our neighbors in the ruddy planet. Our one hope in the present instance of escaping these periodic lucubrations is the possibility that martial affairs on earth may successfully vie in interest with Martian affairs elsewhere.

The question of the habitability of Mars is one to which some of our gravest astronomers have not scorned to direct their attention. A wordy battle has, indeed, been waged on this subject for a generation, and it has been fought with scientific weapons. On both sides there have been two general modes of attack: first, *a priori* considerations as to whether a planet of a certain size, with certain periods of rotation and revolution, and at a certain distance from the sun, could support any form of life, as we know life on earth; second, deductions from evidence actually afforded by the telescope, and latterly by the spectroscope. Nothing has been proved. The "canals" are still exactly as debatable as they were when their existence was first proclaimed by Schiaparelli, nearly forty years ago. While, on the one hand, Professor Lowell and his associates continue to draw certain surface markings of the planet as geometrical spider-lines, we behold a committee of the British Astronomical Association publishing (no longer ago than last summer) an emphatic announcement that the evidence afforded by the last favorable opposition of Mars proves all such geometrical markings, including the "double" canals to be mere optical illusions. We behold doubting astronomers making pilgrimages to the Lowell Observatory and coming away firmly convinced of the objective reality of canals and "oases," while a former member of the staff of the same observatory, after seeing and drawing such objects there for years, solemnly recants and admits that he has been deluded. Lastly, we behold an accumulation of photographic evidence which also, unfortunately, appears to be susceptible of diverse interpretations.

Prof. Lowell's fascinating book, "Mars as the Abode of Life," presents the most complete and circumstantial arguments in behalf of the belief that the planet is inhabited by intelligent beings. Sweeping contradictions have, however, been called forth by this book, and they emanate from respectable sources. Such is the situation up-to-date.

Meanwhile,—to revert to the ideas disseminated by the newspapers and other popular channels of information—it is not uninteresting, as an evidence of the fact that the human mind commonly works in a rut, to note that the hypothetical "inhabitants" of Mars are almost universally assumed to be more or less transmogrified human beings. Why should they be? Are not the chances millions to one against the evolution on another planet, from the simple forms in which life must be supposed to begin (if it begins at all) on any planet, of a vertebrate animal bearing some faint resemblance to man?

Consider that a man and a radish probably descend from a common ancestral species of amœba, or what not, and you will begin to realize what an infinitude of shapes life may assume under various conditions of environment. Given a planet somewhat different from ours in its physical characteristics and its physical history, as Mars undoubtedly is, and we must admit the probability that the progress of organic evolution thereon has led up to things that are neither animal nor vegetable—much less quasi human!

Using Blood in Bread

EVERY housewife knows that bread can be made more nutritious, as well as more appetizing, by adding albuminous substances such as milk and eggs to the dough. But she knows too that milk and eggs are nowadays extremely expensive items, which the ordinary family is unable to use lavishly. But as it happens there is a highly nitrogenous and nutritious substance which might take their place at a far lower cost. This is the blood which occurs as a necessary by-product in abbattoirs. Immense quantities of this are produced annually and this food substance is rich not only in energy producing nitrogenous compounds, but in those mineral salts which are so necessary to the body. Unfortunately, there is a wide-spread prejudice against the use of this valuable food material, the smell, taste, color, and even the idea of blood as food being revolting to most persons.

Now, however, a German scientist, Mr. R. Droste, Staff Apothecary and Food Chemist in Hanover, comes forward with an ingenious method of using denatured blood, so to speak. By using hydrogen peroxide in mixing the "blood bread" the sanguinary fluid is bleached, sterilized and deodored. Moreover, the quantities of oxygen liberated when hydrogen peroxide comes in contact with organic matter form a highly effective means of aerating or "raising" the bread, making the use of yeast or baking powder unnecessary. Mr. Droste states in the *Chemiker Zeitung* (Cöthen), of August 14th, that he has been using bread thus made in his own family for six years and finds it highly satisfactory. Blood is used in place of water in mixing up the dough. Then the peroxide is added. Besides the advantages mentioned above this powerful oxidizing agent kills destructive bacteria in the flour, such as the thread-spinning bacillus, etc. The decomposition products of the H_2O_2 are, of course, water and oxygen, both of which are desirable constituents. Mr. Droste was led to the elaboration of making this cheap, appetizing, and body-building form of bread originally by his investigations on the subject of catalytic decompositions. At first, he tells us, he used a 30 per cent solution of ordinary peroxide, but now he uses a special perhydrite. The blood is allowed to stand in the ice-box for from 24 to 36 hours. The clots are then removed by draining or filtering. The remaining serum with its rich content of nitrogen and mineral salts is what is used to mix up the bread. It may also be used for all sorts of cakes, biscuit, and fancy breads. The author urges its use in times of peace, as well as in the present time of war.

While it is doubtful if the average *haus frau* will be enthusiastic about this substitute for milk and eggs—though in truth blood is the raw material from which both are made!—the idea should receive wide application in armies, public institutions, etc.

Electricity

England to Have Women Electricians.—In order to release for military service many of the men now engaged in the electrical industry, the Electric Contractors' Association of Liverpool, England, has decided to train a number of women in electrical work.

Russian Army Secures Exposition Projectors.—It is understood that the banks of searchlight projectors used at the Panama Pacific International Exposition for securing the "Scintillator" effects have been purchased for the use of the Russian army in the present war.

In the Cleaning of Zinc Ores, an important use has been found for the gas filled tungsten lamp. It is difficult indeed to distinguish between the "black jack" (dark zinc ore) and lead, using other illuminants, since the two appear to be of about the same color. However, under the white light of the gas-filled lamp the two ores are readily distinguishable. It is reported that practically all zinc refineries are now installing 750-watt and 1,000-watt lamps for this purpose.

Electric Flatiron with Heat Control.—An electrical manufacturer has recently introduced on the market an electric flatiron in which a rheostat regulator is provided for regulating the amount of heat applied to the work. Heretofore no provision for controlling the heat has been made in the conventional type of electric flatiron, and it has been necessary to regulate the heat for various kinds of work by turning on and off the current—obviously a crude and time-consuming method.

Telephone Service of Lincoln Highway Motorist.—In order that the motorists traveling on the Lincoln Highway may be in constant touch with garages and communities along the route, it is planned to run a double-copper telephone wire along the highway from Salt Lake City to Ely, and thence to Reno. The plan also calls for cut-in stations at intervals of about 1 mile so that in no instance will a traveler be stranded further than a half mile from the nearest telephone station, from which he can call for relief. Telephone instruments will be furnished to travelers at either end of the route upon payment of a small deposit.

Electric Motor for Phonographs.—No longer is it necessary for owners of the conventional phonographs to crank the mechanism in order to play the records, for there has recently been introduced a small electric motor that can be instantly applied to any disk type phonograph. The motor weighs about three pounds and is made to operate on either direct or alternating current. It is provided with a rubber disk which makes a friction contact with the periphery of the phonograph turntable. With the exception of removing the crank handle, no other change is necessary in converting a phonograph into an electric one, using the small motor.

Consumption of Current for Heating Homes.—According to the *Electrical World,* electric heating has been seriously tried in a great many places in Norway and reports made by a royal commission indicate that a pleasant, even temperature is possible with an expenditure of from 30 watts to 85 watts per cubic meter of space—35 cubic feet. This will keep the temperature of a room at 64 deg. Fahr. with auxiliary heating when the thermometer registers as low as from 10 to 5 deg. Fahr. Under these circumstances electric heating is assumed to be cheaper than other fuel when the energy can be supplied at $7 to $8.25 per horse-power per annum on maximum demand.

A Non-Carbonizing Insulator.—What promises to be of utmost importance in the field of electrical apparatus is the invention of a non-carbonizing insulator by John F. Green, of Pittsburgh, Pa. After several years of study the inventor has succeeded in eliminating ferrous oxide and free magnesia from asbestos, producing a quartz insulator designated as Fibrous Quartz or De Ferroized Asbestos, which is claimed to be absolutely non-carbonizing. The material can be made into any required form. At a temperature of approximately 7,500 deg. it melts and runs not unlike molten steel. Experts who have examined the new insulation proclaim it immune to heat and most promising as an insulating material.

A Dry Storage Battery of the same size and shape as the ordinary dry cell is an offering of an American manufacturer. The new storage battery contains a non flowing electrolyte and, according to the statements of the manufacturer, can be recharged an infinite number of times at a lower price per charge than the original cost of an ordinary dry cell. The rating of the battery is 0.5 ampere for 40 hours, 1 ampere for 18 hours, 2 amperes for eight hours, or 3 amperes for five hours. The average discharge potential is 2 volts. The container of the battery is made of unbreakable paper-fibre, while the elements are of rolled strips of corrugated lead. The electrolyte is contained in an amorphous, non-crystallizing white substance which is claimed to possess exceptionally high absorbing power. A tube is provided in the center of the cell for carrying water in order to prevent the cell from drying out.

Science

Kite Photographs of a Volcano.—A series of remarkable photographs of the crater of Kilauea, Hawaii, have, according to *Science*, been obtained by Mr. C. F. Haworth *by means of kites during the past six months.* The primary object of taking these pictures was to secure additional data for use in the construction of the large naturalistic model of Kilauea that has been under way for the past three years for the geological department of Harvard University.

Effects of Strychnine Sulphate on Quail.—On account of the plague infection existing among California ground squirrels, the U. S. Public Health Service has been co-operating for some years with the California State Board of Health in efforts to exterminate these animals. One method of destruction is distributing barley, poisoned with strychnine sulphate over the infected lands during the dry season. The question has however, been raised whether this procedure might not work havoc among the California Valley quail and in order to obtain information on the subject as requested by the state game and fish commission, tests were recently made at the Federal laboratory in San Francisco. The results were entirely reassuring. It is found that quail may be fed under natural conditions relatively large amounts of strychnine sulphate without showing toxic symptoms, while the California ground squirrel is extremely susceptible to the effects of the same drug.

The North Magnetic Pole.—The late Dr. Aksel Steen, director of the Norwegian meteorological service, had charge of working up the magnetic observations made by Amundsen on his Northwest Passage of some years ago. *Terrestrial Magnetism* publishes a letter written by Dr. Steen, shortly before his death last May, stating that two or three years more would be required to complete the work. The writer declares that it will be impossible to give a definite position for the north magnetic pole, because in his opinion this pole "is not a fixed point attached to a certain geographical latitude and longitude, but must be defined as that point on the surface of the earth where the horizontal intensity at the moment is zero." The discussion of Amundsen's observations will probably show that the pole has a mean daily and yearly periodic motion together with more or less irregular displacements. A mean position for the pole can perhaps be determined, or else it may be possible to define a closed curve within which the pole will always be found.

Climatic Subdivisions of the United States are discussed by Prof. R. De C. Ward, of Harvard University, in the current *Bulletin* of the American Geographical Society. The classification of climates and the delimitation of climatic provinces is a difficult problem at best, and usually something of a makeshift. Various climatic subdivisions have been used in this country for various purposes. The state is a convenient though artificial unit. River basins have sometimes been used, in order that the meteorological data might be most readily applied to the problems of the hydrological engineer. The Weather Bureau in its "Summaries of Climatological Data by Sections" has divided the country into 106 regions, determined partly by state lines and partly by other considerations. Prof. Ward now proposes a good broad subdivision into eight provinces, of which the "Eastern" is by far the largest, as it embraces approximately the eastern half of the country, exclusive of the tier of states along the Gulf, as far west as the middle of Texas, which constitute the "Gulf" province. The others are "Northern Plains," "Southern Plains," "Northern Plateau," "Southern Plateau," "Northern Pacific" and "Southern Pacific."

Loss of Weight of Musk in Dry Air.—Since the sensation of smell is supposed to be due to particles of the odorous substance carried by the air into the nose, it must be assumed that all odorous materials lose constantly in weight. Frequent attempts have been made to measure the loss of weight of musk, but with little success, and one still finds it stated in reference books that this substance gives off its odor for years without losing in weight at all. A very minute quantity of an odorous substance, however, can be detected by the nose, 1 part of musk in 10,000,000 of air, and 1 part of mercaptan in 50,000,000,000 of air according to Fischer and Penzoldt. This subject has been taken up anew by Dr. C. B. Bazzoni, who has made use of a special form of quartz micro-balance, installed in a glass case through which was drawn a current of chemically dried air. This installation prevented the progressive loss of weight of the solid substance from being masked by changes due to varying atmospheric humidity. 1.32245 milligrams of musk lost in 7 months 14 per cent of its weight. The rate of loss varied considerably from day to day, but was much greater in the first part of experiment than in the last, finally becoming almost *nil.* The musk was then removed from the case, and was found to have lost its odor. The odor was not restored by moistening, crushing or exposure to the open air.

Automobile Notes

Leaky Tire Valves.—There is nothing more exasperating than a tire valve that will not hold air in the tire. Fortunately these valves are usually very reliable, but they sometimes go wrong and if a fresh set of interior fittings is not at hand a temporary expedient is to plug up the valve with a bit of soap, after the pressure has been pumped up. Another way is to use some chewing gum. These are old bicycle dodges, but equally as effective for an automobile.

License Qualifications in England.—A recent court case in England calls attention to the inadequate requirements for obtaining a license to drive a car in that country. A blind man was summoned for driving a car, not because he was blind, but merely that he had no license. This case calls attention to the fact that a blind man, a cripple or an imbecile can obtain a license there if he can produce the necessary five shillings for the license fee.

Alleged Diseases of Autoists.—When the bicycle was in the limelight, and the daily papers would publish most anything connected with the subject that came to them, the doctors began to discover, or rather invent many new and fearsome diseases that they claimed to result from riding the wheel. The doctors got their names into the papers, but the diseases never materialized. Now some enterprising member of the medical fraternity has discovered a peculiar knee trouble that he claims to result from continued use of clutch and brake pedals. It will probably join "kyphosis bicylarum" in oblivion after it serves its purpose as a newspaper item.

Lubrication Troubles.—One of the most vital requirements about an automobile is adequate lubrication, and this includes not only the engine and transmission, but numerous other points where friction exists. It has long been appreciated that the old splash system was both crude and inadequate for the engine, and serious efforts are being made to perfect systems of automatic lubrication that will save the engine from the disasters that result from either the neglect or the ignorance of the non mechanical user. But there are innumerable little spots around the controlling levers, brake rigging, springs and what not that depend for their lubrication on a varied assortment of oil and grease cups that are carefully tucked away in unsuspected corners where they escape discovery for months and frequently are never found. This feature of automobile designing has been sadly neglected, and a simpler arrangement would be a strong talking point for the maker who evolves it.

British Post Office Uses Motors.—The dissatisfaction of the railroad companies in the United States with the payments made to them by the government for mail haulage, is as nothing compared to the attitude of the British railroad companies. The British post office department discovered that for short haulage, up to about 125 miles, the motor truck or tractor is far cheaper and better than the railway. For this reason the great bulk of British mail transfer over distances within 125 miles is now made with trucks. The railroads only are allowed to handle the "unprofitable end" of the mail haulage—the whole system resulting in a technical "profit" for the post office department. The contracts between the British government and the railroad companies provides for a flat rate for both long and short haul, with the profitable operation on short hauls only. As however no provision was made in it for the installation of motor trucks by the department, the rail roads are powerless to prevent this sharp practice, and must continue to haul mail at a loss for long distances.

New Storage Battery Helps.—The extraordinary increase of the use of electric starting and lighting systems for automobiles has brought electric storage batteries into the hands of more than half a million people who heretofore never had any occasion to use them and who really did not know their construction. The greater use of electric pleasure cars and trucks too, has widened the field of the electric storage battery. A poorly charged battery is a cause of great inconvenience and it is usually the lack of definite knowledge of the battery's condition that is responsible for the trouble. A few of the latest simple instruments designed to prevent a misuse of storage batteries are the following.

A Hydrometer Syringe—this is intended to show the strength of the battery by means of a hydrometer inclosed in the glass part of a bulb syringe. The glass nozzle is inserted in the storage cell opening, filled with the liquid and the resulting specific gravity read on the hydrometer. 1.300 indicates fully charged, 1.275 is 75 per cent charged, 1,250 is 50 per cent charged, 1,225 is 25 per cent charged, and 1.200 exhausted.

A pocket thermometer for determining the temperature of the battery while charging. Its scale reads from 20 to 220 deg. Fahr.

A pure rubber bulb syringe for filling and equalizing the acid in storage batteries.

Voice-controlled Writing Machine

A New Phonetic Alphabet Based on Speech Characteristics of Sound

A NEW alphabet has been discovered For years *thousands of styluses have been tracing the strange* characters right here in our very midst but the writing has been so fine and so complicated that hitherto the letters have not been deciphered We refer of course to the writing of the phonograph needle which spells out its record *phonetically in cursive* characters that are not arbitrary symbols, like those of man-made alphabets but are definite forms fixed by laws of nature

Three years ago the SCIENTIFIC AMERICAN published a description of a voice-operated typewriter which was then in a purely experimental stage although it gave some promise of success The inventor Mr John B Flowers had devised a system of reeds tuned to respond to various characteristics of speech These by means of electrical connections were adapted to operate corresponding keys of a typewriter If a simple word were spoken into the receiver of the apparatus the keys would automatically respond and write the word

While the vowel sounds were easily detected by the instrument it was exceedingly difficult to distinguish the consonants, and when continued experiment failed to solve this knotty problem the inventor came to the conclusion that he needed a more complete knowledge of the characteristics of human speech Evidently, the difference between two speech sounds such as "B" and "D" for instance, was not one of wave frequency Variation in the number of sound waves would merely raise or lower the pitch, but the *characteristic* "B" and "D" sounds are distinguishable whether uttered by the highest soprano or the basso profundo What then are the peculiar characteristics that enable us to distinguish the various letter sounds? This was the problem that Mr Flowers set out to solve

He realized early in his experiments that speech is not dependent upon the vocal chords, *for words may readily be distinguished* if whispered Hitherto, speech records have always been spoken aloud or sung, with the result that the curves traced have been complicated by fundamental tones and overtones of the vocal chords as well as the mouth tones In order to get a pure curve Mr Flowers decided to make records of whispered speech This he succeeded in doing by the use of an acousticon transmitter coupled to an Einthoven string galvanometer in the manner shown in Fig 6. A cross-section of the acousticon is also shown in this engraving, which shows how the sound waves are gathered by reflecting surfaces and projected with magnified intensity upon the diaphragm The operation of the acousticon transmitter produces electrical vibrations corresponding to those of the voice. These vibrations are conducted through a fine silver plated quartz thread one ten-thousandth of an inch thick. This passes between the poles of an electromagnet, and in response to the electrical variations the wire is compelled to vibrate A beam of light shines upon the wire and its shadow is cast upon a revolving drum fitted with a highly sensitive photographic film By a system of lenses the slightest motion of the string is magnified nine hundred times on the film The telephone receiver shown in the diagram was used as a check on the articulation of the words In order to produce a time record, the light of the arc lamp was interrupted five hundred times per second, thus producing vertical lines on the film at intervals of 0 002 sec.

With this apparatus it was proved conclusively *that it is the variation of intensity* in sound waves that produces speech. For instance, the waves recorded by the sound "B" would vary in intensity according to the pattern shown in Fig 1 If "B" were pronounced on a lower pitch, this pattern would be the same, but it would contain fewer waves, as in Fig 2. The pattern usually lasts at least 0 001 second, when, if the sound continues, it repeats itself

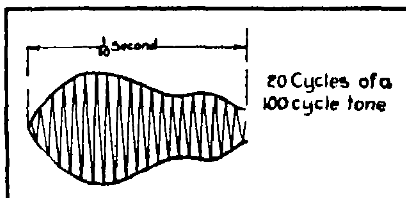

Fig 1 Characteristic intensity curve of the "B" sound

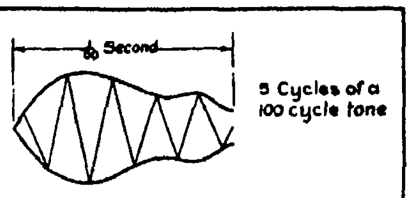

Fig 2. Intensity curve of sound "B" when uttered at a lower pitch

Hundreds of records were made, all of which showed practically the same sound pattern regardless of the age or the sex of the various speakers. Thus a complete phonetic alphabet has been worked out by Mr Flowers, which we have shown in part, in Fig 3, leaving out certain of the vowel sounds.

Having discovered the nature of speech, Mr Flowers then proceeded to design a machine that would record the speech patterns when spoken to The machine is shown in Figs. 4 and 5 It will be understood that the machine does not trace sound vibrations, but merely the curve representing variations of intensity

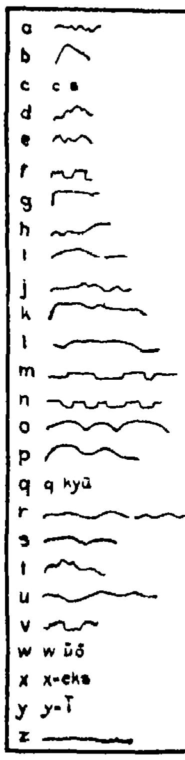

Fig 3 The new phonetic alphabet

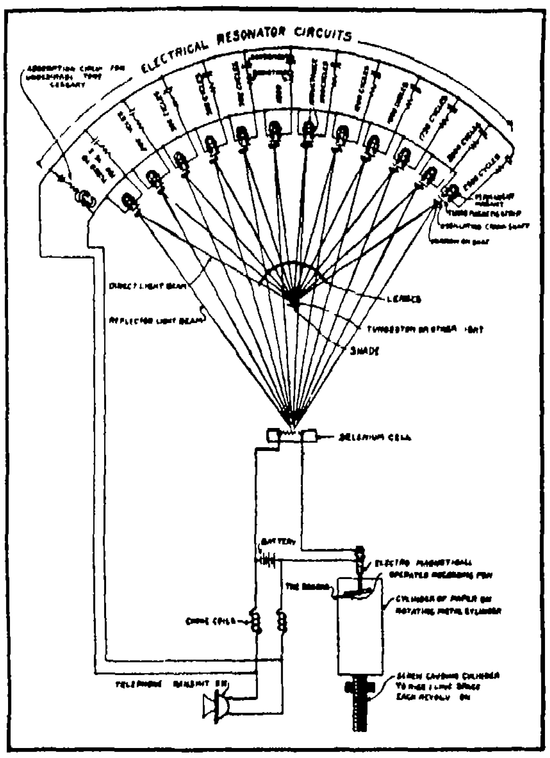

Fig. 4. Diagram of a voice-operated machine for recording speech in the new phonetic characters

On talking into the transmitter, speech-controlled currents pass into the resonator circuits, and the resonator that is tuned to the main tone of the speech at that instant will respond, and the tuned magnetic strip of that resonator will vibrate powerfully As shown in Fig 5, this oscillates a tiny mirror, which throws a beam of light upon a selenium cell, normally the beam falls upon a blank part of the cell, but as the beam vibrates it illuminates more or less of the selenium on each side of this blank zone, producing a variation in the electrical resistance of the cell An electrically-operated pencil bearing upon a cylinder of paper is controlled by the variations of resistance of the selenium cell and thus a wavy line is drawn that records the speech in the new phonetic characters

The reason for having a large number of electrical resonator circuits is to allow for variations of pitch An average man's voice has a pitch lying between 85 and 160 vibrations per second, while a woman's voice will vary between 150 and 320 vibrations. The machine illustrated has not yet been built for all the various pitch cycles shown in the drawing, but it has been constructed to operate on a single pitch

In use, a machine such as this, would produce a record that would have to be transcribed by a typist into Latin characters and English spelling The record made by the machine is fully as easy to decipher as that of a siphon recorder used in cable telegraphy Should such an instrument come into common use, the dictator would soon learn to read the natural phonetic writing, and it is conceivable that in time it might become unnecessary to transcribe the writing into Latin characters. The public would learn a new phonetic alphabet, and the problem of simplified spelling would be solved

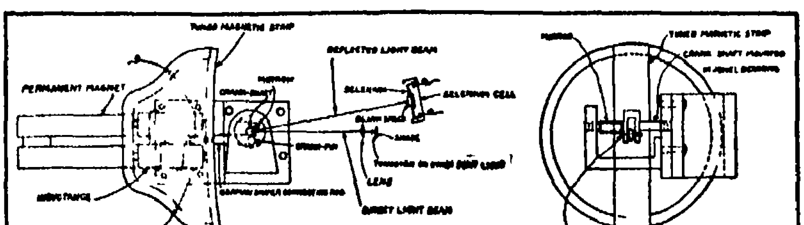

Fig 5. Mechanical arrangement of the mirror-moving mechanism of the voice-operated writing machine

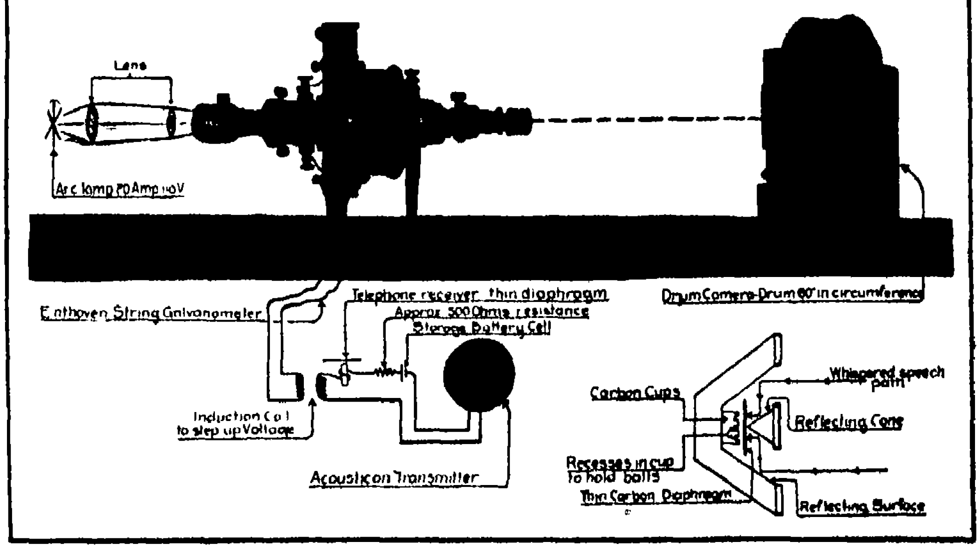

Fig. 6. Apparatus with which the characteristics of speech were studied. The insert shows a section of an acousticon

Radio Direction Finder Invented by Young American

IT is announced by the Department of Commerce that the Bureau of Standards has met with success in the developing of a satisfactory radio direction finder Much interest centers about this device, since the possibility of locating accurately the source of wireless signals is of utmost importance not only to naval and military men, but also to the mercantile marine as a means of avoiding collisions. Furthermore, the direction finder apparatus is invaluable to the radio inspectors of the Bureau of Navigation for the locating of amateur and other stations that are not observing the radio regulations or are otherwise interfering with radio transmission of the Government and legitimate business.

The wireless experts of the Bureau of Standards, under the direction of Frederick Kolster, who, it will be recalled, has contributed materially to the progress of radio telegraphy, have been investigating the subject of wireless direction finding for some time past. The instrument, which they have developed as a result, is said to be simple and practical, and at the same time very efficient in operation. It indicates the direction of the source at the instant the signals are being received, and while it is very sensitive to radiations in a given direction, it is less affected by atmospheric disturbances and interfering radiations from other directions than an ordinary receiving apparatus. It is stated that messages have been received by one or another of the three sizes of instruments that have been built, from Philadelphia, Boston, Glace Bay, Newcastle (N. B.), New York, Norfolk, New Orleans, Panama, Key West, San Diego, and Hanover, Germany. When atmospheric disturbances have been very pronounced on the large antenna at the West Laboratory, they have been very slight on the direction finder apparatus, which is entirely indoors, having no antenna or earth or outside connection.

The new direction finder apparatus appears to be well adapted to use on merchant and naval ships to obtain the direction from any light houses or light ships that may be equipped with radio fog signaling apparatus, to obtain the direction of one ship from another at sea, to communicate between ships or ship and shore stations irrespective of direction by reducing interference and atmospherics, to use by the War Department in field service, as the receiving apparatus is portable and requires no ground or antenna, and can be carried readily in a light vehicle or even by a single observer, and to use by the Bureau of Navigation to locate amateur or other stations that are not operating their transmitting apparatus in compliance with the radio regulations.


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Frederick Kolster of the Bureau of Standards, and the new radio direction finder apparatus

Railroad Wheels That Are Practically Silent

DESPITE the number of attempts made in the past to produce a really silent wheel for railroads and trolley cars, no successful wheel of this type has been generally adopted by the railroad companies. In the course of long-continued tests there always cropped out disadvantages which the inventor had overlooked in the design of his wheel.

At the present time however, Eastern railroad officials are greatly interested in the performances of a new type of wheel which has been undergoing the most strenuous tests and subjected to nearly a year of actual service.

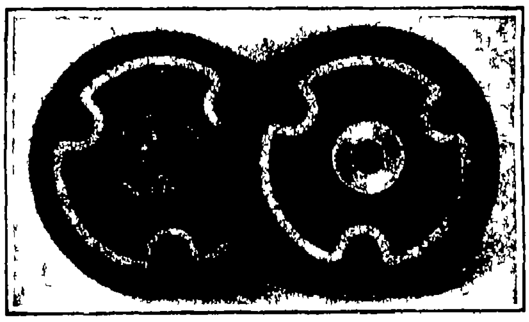
The tests to which the new wheel has been subjected have been carried on without undue publicity, in fact without even the formality of advising the technical press of their purpose. It has been the intention of the inventor as well as the railroad officials, to keep the matter private until the full year trial is over. At the end of this time provided the wheel has shown its many advantages to the satisfaction of the railroads, it is to be manufactured in quantities.

The writer was informed of the object of these tests in October, 1915, and after some difficulty succeeded in obtaining a short technical description of the wheel and some photographs of the first two sets made. Since April 8th, these wheels have been in continuous use on one of the trolley cars in Portland, Me., and a complete daily record is kept of the performance. During the first six months of the strenuous test the wheel proved so satisfactory that a large order is now being arranged for, while a plant is to be erected for the manufacture of the wheel in large quantities.

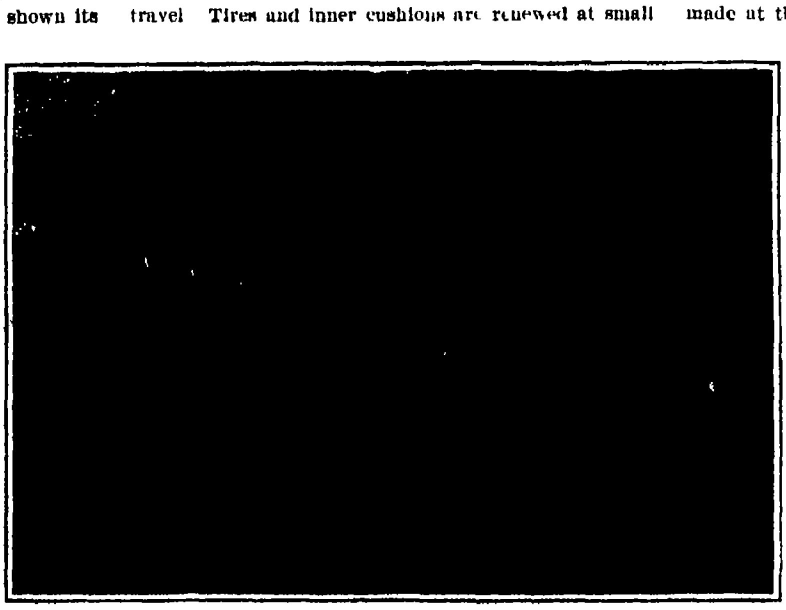
The new wheel, as will be seen in the accompanying illustrations, consists of two distinct wheels—a wheel within a wheel—separated from each other by an irregular cushion of rubber. The shape of this cushion represents the results of innumerable tests with shock absorbing devices. It absolutely prevents both forward and backward creeping. It is claimed, without the use of lugs or bolts. In actual use, of course, the sides of the wheel are protected against dirt, dust, and damage by steel plates, while the rubber cushion is prevented from moving laterally by the same disks.

Among the advantages claimed by the inventor, and so far borne out by the tests made in Portland, are the following: First, several times the tire service of an ordinary cast iron wheel; second, tires are easily removed and renewed; third, wear of the cushion proper is estimated at four years on average trolley service; fourth, steam railroad tests indicate its good influence on the rolling stock, rails and switches which are subjected to much smaller shocks; fifth, on city and inter urban trolley lines the question of excessive noise is solved to the satisfaction of residents along the routes; sixth, greatly improved riding qualities of the cars and greater comfort for the passengers.

In order to forestall the incorporation of any possible defects in the wheels when these are to be placed on the market the inventor has resolutely refused to accept definite orders until the tests in Portland are completed. In the meantime residents along the line on which the silent car is operating are highly pleased and interested while the railroad officials look on with increasing approval. They estimate the life of one of these silent wheels at 300,000 miles of actual travel. Tires and inner cushions are renewed at small expense whenever new ones become necessary.


Interior view of the silent wheel with both cover disks removed, showing the shock-absorbing cushion

Edwin C. Madden, the inventor of this wheel, was Assistant Postmaster General under the McKinley Administration, and is the originator of the little stamp booklets now sold throughout the United States to the public, incidently making a profit of about $150,000 a year for the Post Office Department.


Outside view of a group of Madden silent railroad wheels, with the steel side disks in place

The Solar Constant of Radiation

THE June issue of the *Proceedings* of the National Academy of Sciences contains a note on the solar constant of radiation by C. G. Abbot, F. E. Fowle, and L. B. Aldrich, who made nearly one thousand determinations of the solar constant between the years 1908 and 1914. The observations were made at Washington (at sea level), Bassour in Algeria (1,160 meters above sea level), Mount Wilson, California (1,780 meters) and Mount Whitney, California (4,420 meters).

Langley's spectrobolometric method was employed, the atmospheric absorption being computed from measurements of the distribution of energy in the solar spectrum at different zenith distances. The bolometric measurements were reduced to calories by daily comparisons with standardized pyrheliometers. The mean value found is 1.93 calories per square centimeter per minute.

The close agreement of the values found at different times and places, although both the direct measurements and the computed atmospheric absorption were greatly affected by differences in temperature, barometric pressure, humidity and haziness, seems to be strong evidence of the soundness of the method.

Furthermore, the atmospheric transmission coefficients obtained at Mount Wilson agree well with Rayleigh's theory of atmospheric scattering. From these coefficients Fowle has computed the number of molecules per cubic centimeter of air as 2.70×10^{19}, which is very close to Millikan's value (2.705×10^{19}), obtained by absolutely independent methods.

Another evidence of the soundness of the work is the fact that simultaneous observations at Mount Wilson and Bassour agree in showing an irregular variability in solar radiation which has recently been confirmed by measurements of the distribution of brightness along the sun's diameter.

Nevertheless, it has been objected that 1.93 is much too low a value for the solar constant, that higher values have been obtained for the uncorrected solar radiation on mountains and from free balloons, and that the correction made for atmospheric absorption was too small because no observations were made within 15 deg. of the horizon.

In order to meet these objections observations were made at Mount Wilson from sunrise until 10 o'clock, on September 20th and 21st, 1914. On both days the atmospheric transparency remained sensibly unaltered. The values found for the solar constant fall between 1.90 and 1.95.

In July, 1914, a recording pyrheliometer was raised by sounding balloons to an altitude of about fifteen miles, where the barometric pressure was one-twenty fifth of the pressure at sea level. The mean value of the best records of solar radiation thus obtained at highest altitudes is 1.84 calories per square centimeter per minute. The highest reliable direct observations of solar radiation range from this value downward to 1.58, made at the sea level at Washington.

Germany's Substitute for Cotton

GERMANY'S supply of cotton, so necessary for the manufacture of modern high explosives, is low enough that a diligent search is being made for adequate substitutes. England has cut off the foreign supply and thousands of tons are demanded for comparatively short campaigns.

So far the hope has been that cellulose from some special wood might be nitrated successfully into gun-cotton, but that success has not yet been reported. A measure of success in getting a substitute has been obtained, however, in using certain forms of paper pulp, lignin, etc., as a dressing for wounds, thus saving some of their precious cotton for explosives. One firm in Berlin is selling "Lignin" as an absorbent for blood at a price of about eight cents per pound in hundred pound lots. It is put up in sheets about fourteen by twenty four inches and in packages of eight pounds or rolls of two pounds.

One of the most effective wound dressings among these substitutes is sphagnum moss, which to some extent had been used in both England and Germany before the war. The moss is so full of minute tubes that in its ordinary state it holds nine times its own weight of water and is therefore a powerful absorbent when dry. It is very soft and light. Gathered from the swamps, it is dried on rocks or bushes until bleached white, then cleaned and sterilized

Strategic Moves of the War, February 4th, 1916

By Our Military Expert

IT is a long jump from Macedonia to the western battle lines and the recently initiated Teutonic offensive in that locality, but there evidently exists a close relationship between the two

Ever since the Entente gains in the autumn of 1915 when the Germans barely were able to check an advance of moment, Teutonia has maintained a very tenuous foothold on the ends of the ridges that extend from the Channel to various points on the battle front north of the Oise Fighting on a hilltop with the slope behind the defensive line is no sinecure and is fraught with disastrous possibilities should the defense fail to hold At several points the Germans were forced back until their trenches teetered precariously on the hills—and they had not sufficient strength available at the moment to launch a counter attack with an ample weight to give promise of recovering the lost territory Almost every possible battalion had been stripped from this front to engage on the eastern line and in the *Balkans At the same time, the advantage of the defensive* proved so great that Germany could hold off her assailants at the last moment and prevent their breaking through

The general situation and especially the necessity for securing a toe hold at Saloniki for a future day required the reinforcing of the Entente position at this point thereby taking away troops that might otherwise have secured a local victory at the expense of giving up the hold on the Grecian port

A glance at the map shows the general position in France to be that of a huge, rough salient The very existence of such a salient is a menace in itself It is evident then that the constant activity on the side between the Oise and Flanders as well as that on the other between Rheims and Verdun, a constant pecking and striving means much There has been comparatively little activity at the blunted apex The western line in acknowledgedly superior Entente strength has seemed comparatively calm in proportion to its power the oft heralded general offensive has been lacking movements which seemed to presage such an undertaking petered out into mere local activities

Yet, both Entente and Teutonia know that it is certainly coming eventually The latest German strokes, therefore, undoubtedly constitute an effort to secure a better local position for various sectors of defense against the breaking of the gathering storm

When the offensive develops it will logically move eastward against the northern leg of the salient and northward through the Champaign district Both ways lie thickly strewn with fields of defense obstacles and myriad trenches backed by hundreds of guns The very trenches and faults of the ground must run crimson before such attacks win through, the cost in men will be so appalling that the civilized world will gasp when the full story is told Yet this sanguinary assault must be made—unless something collapses within the Central Empires

But if successful, if sufficient strength is marshaled to carry home these thrusts, the intervening territory embracing Laon St Quentin and Cambrai will form a great cul-de sac in which enormous Teutonic forces and material should be bagged unless peril of the position is realized in time to permit them to make a withdrawal

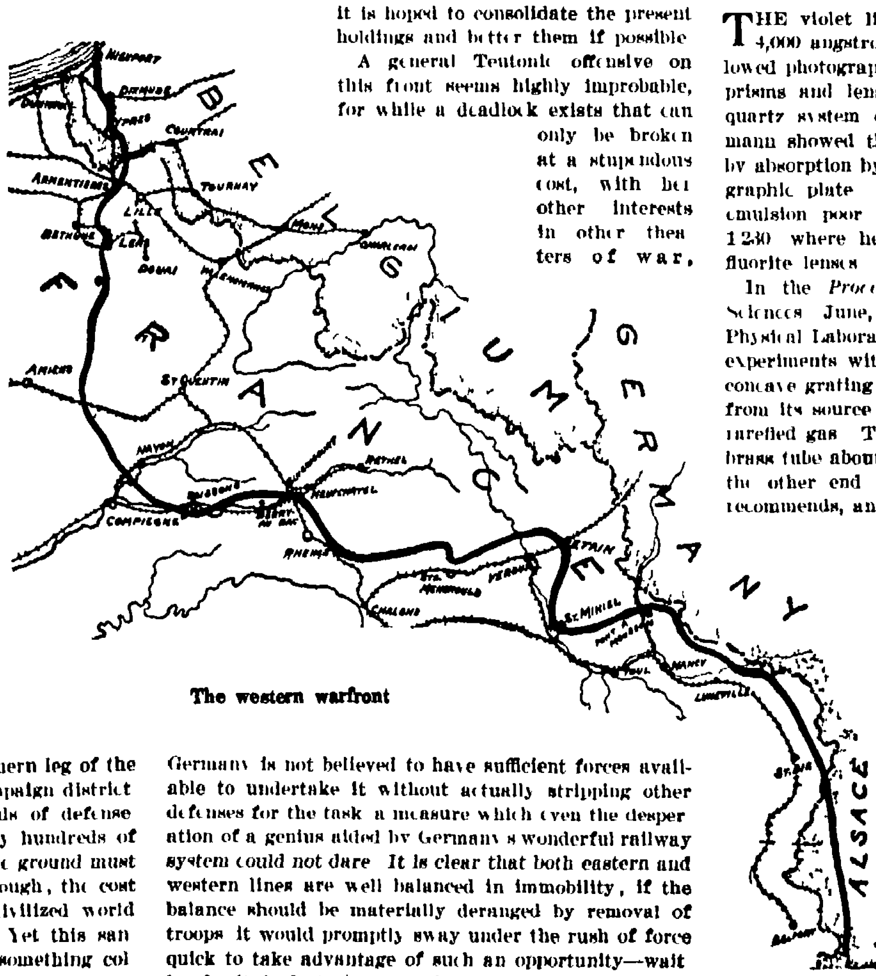
Beyond the shadow of a doubt, should such a success come to pass French territory would at once be cleared of invaders, and Germany would then be compelled to fall back along the whole line probably resulting also in the accompanying clearing of at least a part of Belgium

The public has grown so accustomed to measuring gains and losses on this line in terms of yards that the resulting gain of ground from a successful piercing of the sides of the salient would probably appear as a decisive victory with its reacquisition of hundreds of square miles at a blow That would be a mistake, for then the Teutonic line would have become automatically straightened and shortened, have been brought closer to points of supply and have been forced back only to stronger positions of defense the further back the stronger fortifications upon which to rest the line And the whole thing would have to be done again It is almost inconceivable under existing conditions even should Germany be compelled to evacuate French territory and Belgium that the Entente could easily continue an offensive to pierce through to Germany, the war is to be won if it is won within the year or so, through cooperation blockade by land and sea, loss of morale by Teutonia, and through diplomacy not merely by force of arms Local successes, general successes, are desired and needed by the Entente, but the material gain will be found to lie in the tightening of the bonds more than in an actual storming of interior fortified lines. They are too strong.

This is not intended as prophecy, for it is but outlining succeeding probabilities founded upon the ground, the position its extent and general contour, the measure of local activities, the estimated strength of the contending forces, the general situation, the obscurity of Entente preponderant force and the fact that should the Entente consent to a cessation of hostilities, with Teutonia occupying her present advanced holdings the Kaiser would have won his war hands down—a some *thing utterly incompatible with existing resources in* men, money and munitions possessed by his enemies

Now that Germanic forces have been released from immediate activity in the Balkans they are available for a shift to the eastern or western line, and the recent offensive serves to suggest that for the time being the latter has been chosen for a first venture by which it is hoped to consolidate the present holdings and better them if possible

A general Teutonic offensive on this front seems highly improbable, for while a deadlock exists that can only be broken at a stupendous cost, with her other interests in other theaters of war, Germany is not believed to have sufficient forces available to undertake it without actually stripping other defenses for the task a measure which even the desperation of a genius aided by Germany's wonderful railway *system could not dare It is clear that both eastern and* western lines are well balanced in immobility, if the balance should be materially deranged by removal of troops it would promptly sway under the rush of force quick to take advantage of such an opportunity—waiting for it, in fact—in strength It is at least four times harder to take new ground than to hold ground already possessed, and Germany can scarcely afford the cost of another general offensive She is now constructively on the defensive, her advanced holdings guarded by a rim of steel of quadruple delineation, although necessity demands that she make good her footing wherever possible to wait for developments and welcome any opportunity for peace—so long as she remains where she is.



The western warfront

When the Entente offensive is launched at last—it may be within a few weeks or it may be postponed until spring and summer are blending—if it is to be endowed with the attributes of success, activity must be displayed by its allies on every front. Russia must throw her reorganized legions forward in hopes of suc*cesses—in any event, to cause the retention of power*ful force against her that it may not be shifted Macedonia must again become a field of battle, more terrible more complex than ever before And the French front must blossom into flame from Nieuport in Flanders to the "Last Post," near the Swiss frontier, while the mighty attacks are launched upon the enormous salient.

It takes a great deal of time to prepare for such an assault Not only on the actual front to be stormed, but on all others—shells, shells, shells, must be up and ready for every available battery, and line after line of men must be in position to sweep forward, to be deliberately sacrificed that their following fellows may gain ground, opposed by steadily lessened strength through the degree of punishment inflicted by those sacrificed before they fell

The French, dominant factors on the western line, have waited wisely, content to let their opponent wear down by fruitless beating on the bars while they and their allies prepared France was *not* ready for war when it came, England was grossly unprepared, and it has taken every bit of the time intervening until the present to gird their loins.

It would seem as though the Entente should be ready at last, but a little further time of preparation must ensue through the state of the ground, which is muddy and slippery, for the winter has not so far been a severe one The first spell of warm weather that will dry things up should witness a rustle of preparation, the shifting of troops at night, the massing of guns under concealment and the concentration of munitions, *for when a rush is to start across a fire-swept expanse* of land, every second—fraction of a second—is of untold value, that the period of exposure before the bayonets lock breast to breast may be cut down to a minimum

The Extension of the Spectrum Beyond the Schumann Region

THE violet limit of the visible spectrum is about 4,000 angstrom units, but the spectrum may be followed photographically to wave-length 3000 with glass prisms and lenses, and to wave-length 1 850 with a quartz system or a reflecting grating Victor Schumann showed that this limit (1 850) was determined by absorption by the air and the gelatine of the photographic plate With a vacuum spectroscope and an emulsion poor in gelatin he reached a wave length 1 230 where he was stopped by the opacity of his fluorite lenses

In the *Proceedings* of the National Academy of Sciences June, 1915, Theodore Lyman of Jefferson Physical Laboratory, Harvard University, describes his experiments with a vacuum spectroscope containing a concave grating arranged so that the path of the light from its source to the photographic plate is wholly in rarefied gas The grating is mounted at one end of a brass tube about 40 inches long and 4 inches wide At the other end are the plate, prepared as Schumann recommends, and a slit admitting light generated electrically between tungsten electrodes in a quartz tube which communicates freely with the air tight brass tube.

In the earlier experiments with a strong disruptive discharge in hydrogen at 2 or 3 millimeters pressure the spectrum was extended to wave-length 900 In later experiments with helium free from nitrogen the limit was extended to wave length 600

Three hydrogen lines, predicted by Ritz on theoretical grounds were found at 1,216, 1,026, and 972 With pure hydrogen they are best seen with a disruptive discharge, but an alternating discharge of 60 cycles produces them in helium containing that trace of hydrogen so difficult to remove The disruptive discharge is required to produce the seven or eight new helium lines of wavelengths less than 900

The limit now reached is set by the adjustment and dimensions of the apparatus, and Lyman sees no insuperable difficulty in further extension A considerable region remains for exploration between 600 and 1 angstrom unit, which is the wave-length of X rays, as determined by the Braggs.

The World's Forests

DESPITE the warnings of economists concerning wasteful deforestation, particularly in our own country, it appears from recent investigations that a goodly portion of the earth's surface is still heavily wooded According to the *Naturwissenschaftliche Umschau* (Berlin) the world's forests are divided as follows

The American Continent	646,752,000 hectares
Asia	370,000,000 "
Europe	314,500,000 "
Africa	230,000,000 "
Australia and Oceanica	95,000,000 "

The most notable fact is that out of this billion and a half of hectares of forest land, Europe should possess a share so relatively large, considering her area

Industrial Preparedness for Peace

The American Declaration of Economic Independence

By Prof Thomas H Norton, Ph D, Sc D.

Bureau of Foreign and Domestic Commerce Washington

THERE is a note of preparedness in the air The word is on every tongue from the Atlantic to the Pacific. To meet it means adequate preparation against any possible menace to our political and national independence coming from across the waters which wash our eastern and western coasts

To our financiers, our economists, our captains of industry, it implies much more. It denotes timely provision for the vaguely defined changes which we all feel must inevitably follow the conclusion of the terrific struggle now raging over Europe, and profoundly affecting Asia and Africa

The Europe of 1920 may show little resemblance to the Europe of 1913, politically or industrially, in ideals or in activities The America of 1920 may be affected in a less degree, but unquestionably we shall have advanced far in the evolution of our national existence accomplishing in years what otherwise might have required decades

Half revealed to our vision is a nation financially as independent as it now is politically the banker of the Western Hemisphere—possibly of the world! The initial steps are taken to create an American mercantile marine, able relatively to make our flag as familiar in the ports of the world, as in 1860, when our white-winged fleet traversed every highway of the oceans

Simultaneously with the swift evolution of world wide plans in finance and transportation has come the conviction that the golden opportunity is at hand—within our grasp—to make this United States of America industrially independent to free it from every shackle other than those rigorously imposed by climate or the geographical distribution of mineral resources

These past eighteen months of warfare on a gigantic scale, hitherto unknown in the history of this globe have taught us many lessons The need of more adequate provision against an invasion of our territory is one lesson. It is, however, of minor importance compared with the great economic lesson conveyed to us each passing day, while vast waves of conflict slowly painfully, horribly ebb and flow

The organized productive activities of this land agricultural and industrial are gradually forming the iron resolve that never again shall they be exposed to the anxiety, the uncertainty the loss resultant from widespread dependence upon foreign sources for a multitude of products vitally essential to the very continuance of scores of gainful occupations The lesson has come suddenly and brusquely—like a blow in the face. Time is required for its application, but on every hand are evidences that it has been well learned

As the outcome of private initiative largely but occasionally as a result of combined effort one after another industries are being planted upon our soil which are destined to release us from further economic dependence upon European manufacturers for a large number of the most varied articles The instances are multiplied daily Individually they scarcely awaken public attention In the aggregate they present a remarkable testimony to the keen and alert manner in which American enterprise and technical skill take advantage of sudden and unexpected opportunities

In a somewhat more genial but equally resolute manner, the American industrial of 1916 is issuing an economic Declaration of Independence, worthy to be ranked alongside the political Declaration of his great grandfathers of 1776, some 140 years ago

Noteworthy and instructive are the concrete examples of the manner in which this Declaration assumes form Space does not permit the mention of more than a few of the interesting examples of new branches of manufacture, suddenly but still in a thrifty, enduring manner, called into existence during the past year and a half, displacing permanently in our domestic consumption wares to the value of many millions, hitherto imported from Europe.

Our knit goods industry has developed steadily of late years, but for many specialized forms we have been dependent upon the factories of Saxony The annual imports of these articles amounted before the war to $2,200,000 We are now supplying fully our own needs in this line, and furthermore our mills are now shipping annually knit-goods worth $16 240 000 to other countries. A year ago this export amounted to $2,547,000. Similar cases may be cited from other textile branches.

The curved faces of our watches and clocks came to us, formerly, exclusively from the glass works of Thuringia. The imports suddenly ceased in the autumn of 1914 Manufacturers of timepieces laid their needs before leading American glass makers. Within a month the problem was solved. The curved disks were made a regular article of manufacture. Their quality was beyond criticism A second month passed, and the cost of production sank below the former current prices of the foreign makers

The paper trade offers some interesting examples of the process of emancipation, now in progress Lately we expended $1,350 000 annually in Germany for lithographic labels The domestic demand is now met entirely by wares made in American mills Fancy and surface-coated paper, brought from Germany cost us annually $2 150 000 This also, is now made entirely in our own mills Our countless souvenir postals came also largely from Germany We sent $420 000 each year across the ocean to pay for them Now they are likewise supplied by American factories Photographic paper from Germany cost us annually $720 000 That too, is now all made at home, to the relief of every amateur and professional photographer

Two years ago we expended nearly $1 800 000 for German toys There was no lack observable when Santa Claus distributed his bounty last Christmas Eve He however filled his bag to the utmost limit for once with the products of American taste ingenuity and adaptation to juvenile needs In the future he will load his reindeer sleigh with wares from the same source Among the varied supplies of the marvelous sleigh were bon bons of foreign origin We imported annually German confectionery to the value of $150,000 Last Christmas the palates of Young America were amply satisfied with the homemade product, and that will be the case in the future

Many a child was delighted at Christmas by his first box of colors He may not have noticed particularly the dainty soft brush with which they are applied. There was consternation, however fifteen months ago among his elders gaining as artists their livelihood for whom the brush is an indispensable tool Germany was the sole place of manufacture and there was a total cessation in shipments Promptly an American firm specializing in artists' supplies, took up this branch Incidentally it was found that the essential raw material consisted of fine hairs, from the inside of the ears of cattle, and further that the material came from the slaughter houses of Chicago The steers of our Western plains will henceforth contribute their quota to American artistic activity without being forced to make a double trip across the Atlantic

Of the smaller musical instruments we have hitherto imported from abroad articles valued at nearly $1 500 000 or about one third of the domestic consumption These purchases from music loving Germany have long since ceased, and the American manufacturers are now fully meeting current demands

Despite the recognized excellence of American steel we have imported annually from Germany cutlery valued at $1 000 000 This export also, has ceased, and American knives razors and scissors are fully satisfying American needs

Our domestic output of paints and pigments is very large Our yearly import of wares in this category from Germany has, however exceeded $1 000 000 This item is likewise replaced now by colors made in American works

The glove industry offers an admirable illustration of how quickly a domestic branch of manufacture can emancipate itself from foreign dependence Until recently we purchased annually from Germany glove leather valued at $1,750 000 and leather gloves valued at $4,200 000 There is no lack of such gloves in our stores this Winter They are however made in American factories, from raw material prepared in American tanneries

And so I might pass in review a number of industries, dependent ordinarily upon European sources for semi manufactured material or for important categories of finished goods ready for consumption The pendulum has steadily swung to the Occident. Individual items represent values of a few hundred thousand dollars or one to five millions. The aggregate is imposing It means an industrial Hegira without counterpart in the economic annals of the world a reproduction to the nth degree of that flight of Gallic skill and inventive power to British shores, consequent upon another epoch of blood and carnage, ushered in by the night of St Bartholomew

All students of history know to what an extent British predominance in textile manufacture and in many other branches was due to the results flowing from that deplorable outburst of religious and political fanaticism

A similar black-bordered page in the records of European civilization is being painfully penned in letters of blood. For the citizens of this country saved by geographic conditions from being drawn into the maelstrom of jealousy ambition and passionate struggle, it spells OPPORTUNITY in blazing letters Before us is the opportunity to achieve industrial freedom, without laying ourselves open to the accusation that, in the midst of the peaceful regular exchange of international products there has been any deliberate attempt to cripple or kill a foreign industry dependent largely upon its American market

Under ordinary circumstances we possess legally the right to build up our domestic industries even at the expense of foreign competitors Under the existing circumstances of the long drawn out contest for life or death between the European powers with no apparent date for a conclusion of the titanic struggle, involving a progressive destruction of productive equipment and the machinery of commerce, it is not only a legal right but an ethical duty an exercise of the highest patriotism following an elementary law of self preservation to save our economic fabric from threatened dislocation and anemia by the prompt creation upon American soil of the requisite industries in such form as to adequately and permanently insure the nation's material life from all danger, actual and prospective

I have purposely reserved until the close any reference to the most important field in which this movement towards emancipation is making itself powerfully and noticeably felt

In no province of applied science has the United States, in common with the rest of the world, been so largely dependent upon foreign manufacture as in the case of chemical technology In producing a few leading staples soda sulphuric muriatic and nitric acids, explosives the alums, acid phosphate, copperas blue vitriol etc we had reached the point where the country's ordinary demand was met by the domestic output. For the great mass of chemical products we were obliged to seek foreign sources chiefly in Germany There are few industries not dependent upon a varied supply of chemicals Our agricultural interests were forced to import Chile saltpeter for their nitrates and turned to the mines of Stassfurt for their potash The colors for our vast textile industry with an annual output worth $1 640 000 our leather, paper ink paint and varnish branches with a total output valued at $1 550 000 and scores of minor industries originated chiefly in Germany The complete list would be of great length

The problem here is one of enormous difficulty, resultant from the bewildering complexity of chemical industry as a whole and to an exceptional degree in the case of the coal tar branch It is however being resolutely tackled, and the victory is fairly in sight.

In the case of barium compounds of oxalic acid, of the ferro cyanides of sodium of the peroxides, and several other categories in part the requisite plants have been created and the full demand of the country will soon be met

The coal tar chemical industry offers the most serious difficulties and makes the heaviest demands on capital and enterprise as well as on technical and scientific attainments. Note however what has been done during the 18 months since the European war began *

The output of the so-called coal tar crudes benzol, toluol xylol phenol napthalene etc from American coke plants gas works and tar distilleries for the entire calendar year 1914 was about 14 400 short tons The monthly output of these products at present is about 33 000 tons (This includes 10 000 tons of synthetic phenol The 8 500 tons of benzol required in its preparation should therefore be deducted from the above figure leaving a net total of 24 500 tons)

During the year 1914 we manufactured less than 900 short tons of aniline, and imported 1 500 tons. Today twelve American firms are manufacturing this fundamental intermediate for the production of finished dyestuffs at the rate annually of 10 500 tons These firms are manufacturing also 2 600 tons of other non-tinctorial derivatives of benzol

During the year 1913 we consumed 20 000 short tons

(Concluded on page 184)

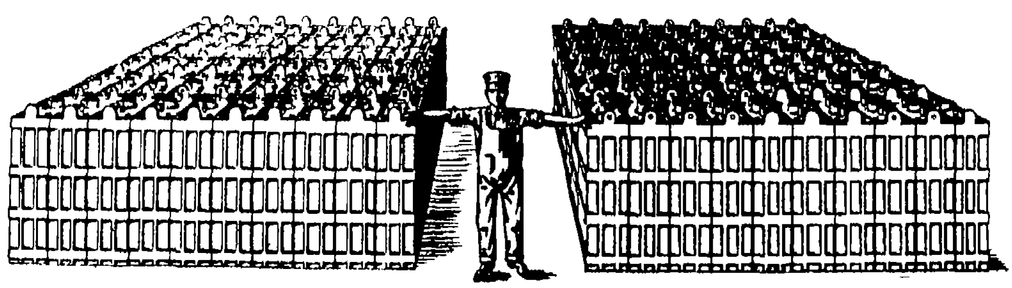
* A very full study of all the factors connected with the establishment of a comprehensive self contained American coal tar chemical industry appeared in the SCIENTIFIC AMERICAN for November 6th and 13th, 1915

The Stored Energy of the Submarine

The Silent Power That Has Made Under-water Navigation Possible

ALTHOUGH the idea of under water attack dates back to the Revolutionary War, it was not until the storage battery was perfected that the submarine became a practical weapon of war. No matter how formidable in attack the submarine may be, in defense it is the most helpless little craft imaginable. The barest touch of a ship's keel will rip open its thin shell and send it to the bottom. Its only refuge is the sea under whose cloak it may lurk in wait for the enemy, and in whose depths it may hide after it has hurled its bolt. It can live only by stealth and so in order to steal through the water without awakening a suspicion of its presence it must be equipped with propelling power that is absolutely noiseless and leaves no visible trace of its operation. The storage battery and the motor it energizes are almost ideally suited to the requirements of the submarine, for they are silent and practically heatless, leaving no trail of bubbles to betray the whereabouts of the submerged vessel.

Needless to say the submarine calls for a special type of accumulator and it is a giant compared to the batteries seen in the common walks of life. Some idea of the size of battery required in our large new submarines may be had from the accompanying sketch. The battery consists of two units of 60 cells each and the space occupied by each unit is about 12 feet long by 12 feet wide and 50 inches high. The two units are usually separated by a bulk head, but, combined, they are long enough to reach across a city lot. A complete battery of two units will weigh between 60 and 70 tons and their capacity will be approximately 3000 amperes for one hour. These dimensions and weights refer of course, to the lead type battery which is almost universally used. It may be interesting to note that of the 77 submarines in the United States Navy 76 are equipped with lead type batteries and only one, the ill fated "E-2," in which a disastrous explosion of hydrogen occurred the other day is equipped with a nickel iron battery. Of the 38 submarines now being constructed or authorized, 35 have been or are to be equipped with lead batteries and one is to be equipped with a nickel iron battery while contracts for the remaining two have not yet been let. In defense of the storage battery it may be said that no calamity has ever occurred on land or sea due to explosion or other effect of gas from a lead battery.

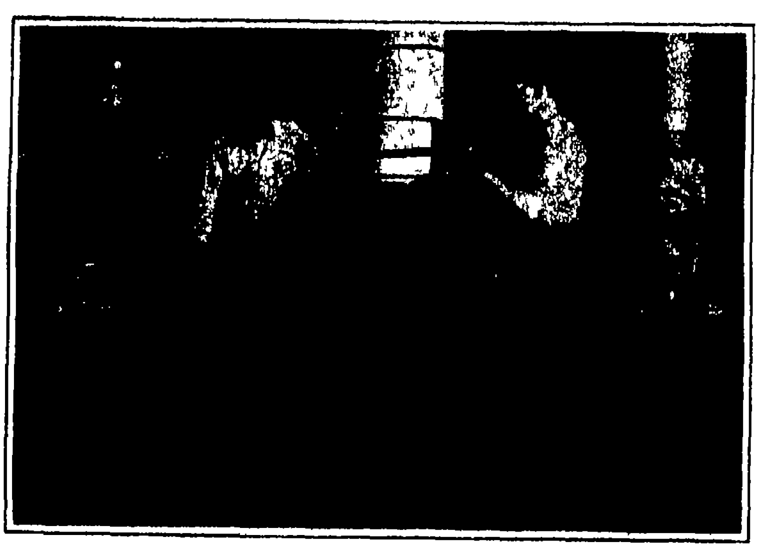


The storage battery for a modern, large submarine consists of about 120 cells, arranged in two units, each measuring 12 feet square by 50 inches high

In the earlier days of the submarine it was not realized that a special form of battery was required for this use. At first the batteries were of the open type construction, that is, the individual cells had no covers. Now, submarine batteries are carefully sealed so that the electrolyte can never spill and so that salt water cannot enter the cell and come into contact with the sulphuric acid of the electrolyte and produce chlorine gas. In the latest type of battery each individual cell is sealed. Unfortunately, it is impossible to seal a storage battery absolutely, for both in charging and discharging it generates hydrogen and oxygen gases. These must be carried off and dissipated in to the hold of the vessel. For this reason, separate air inlets and outlets are provided for each cell which connect with a ventilating duct equipped with an exhaust fan that draws off the gases. As the air passes out of the cell drawing with it the dilute gases it passes through a number of screens which remove from it all traces of the electrolyte.

The accompanying photographs have been taken in a factory which produces the majority of submarine batteries used by our Navy and they show the construction of one of the latest types of batteries. A particularly novel feature is the formation of the positive plate. This consists of a series of rods or pencils of lead antimony alloy, which are inserted in hard rubber tubes and are connected at the top and bottom to lead bars. The rods are provided with lugs which center them within the tubes and the tubes are filled with lead peroxide, which constitutes the active material. The hard rubber tubes are provided with thousands of fine horizontal saw cuts which are too narrow to permit the active material to pass through, and accumulate. This obviates one of the difficulties heretofore experienced in which the material was apt to fall to the bottom of the cell and accumulate in the form of a sediment, producing a short circuit.

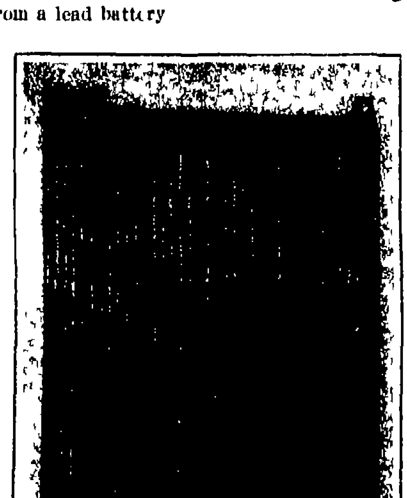
A special machine has been provided for sawing these tubes, which is shown in one of the photographs. A very fine circular saw is used which makes 660 cuts per foot. The machine is automatic in operation, feeding each tube step by step to the saw and leaving an unsawed space at each end of the tube. The pencils are cast in the form of a grid with their lower ends free, but the upper ones fast to the top bar. After the rubber tubes have been fitted upon the pencils the grid is passed to a special machine that fills the tubes with lead oxide. This machine is shown in one of the photographs, but the plate that is being filled is not of the submarine size, although the operation is exactly the same. The active material is in powdered form and it is shaken into the tubes by a violent jarring action which the operator can watch through a glass window. This done, a strip of lead is burned on the bottom of the pencils and the grid is then ready for the forming process.



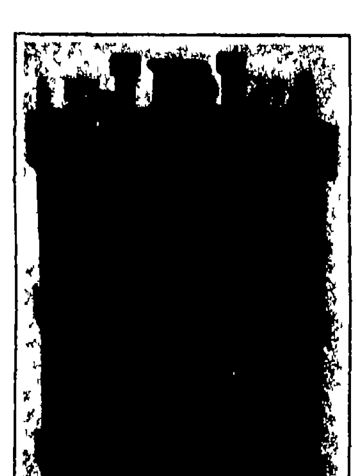
How the grids are cast for the positive plate of the battery

The negative plate consists of lead grid filled with lead oxide paste. Thin sheets of wood, in some cases ribbed, and treated to remove all resinous material, serve as spacers between the plates. The container is made of hard rubber to eliminate the danger of short circuits and electrolysis should sea water leak into the battery compartment.

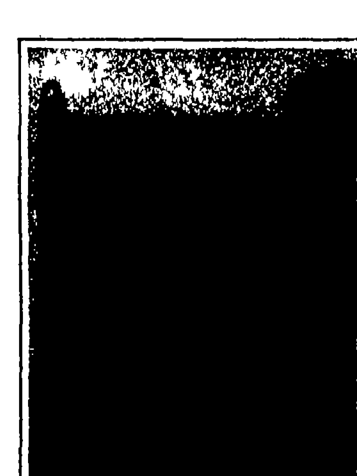
A special feature of the cell is the filling plug which is so arranged that the cell cannot be overfilled. The plug is removed by giving it a quarter turn which closes a valve that prevents overfilling. The water rises in the filling neck and thus indicates when sufficient water has been added. After the plug has been inserted again, no dust or impurities can get into the cell and even if the battery were submerged in salt water the water would have to stand several inches above the top of the cell before it could force its way into the electrolyte. Thus the danger of generating chlorine gas which has been made so much of in the daily press is practically non-existent.



The positive plate, showing the rubber tubes in which the active material is retained



Submarine storage battery cell about 50 inches high. Note how completely it is sealed



The negative plate, consisting of a lead grid filled with lead oxide paste

The Current Supplement

IN the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2093, for February 12th, 1916, there is an article on *The Inner Life of Some Common Plants* that tells of the chemical faculties of plants that are related to their growth, color activity and other characteristics. *Surface Tension at the Interface Between Two Liquids* is a subject that will interest many. *A Differentiator* describes an ingenious new instrument that enables the engineer to lay out curves that are of great service in solving some of his problems. The construction and operation of this instrument is illustrated by several drawings and photographs. *A New System of Cutting Gears*

describes the so-called "ooidal system," which is claimed to produce gears that run long and smoothly. *Ore Unloading on the Great Lakes* is a most interesting story, telling how the immense increase in the shipments of ore on our inland seas compelled the invention and development of ingenious machinery for the rapid handling of great quantities of material. A large number of photographs illustrate these wonderful machines that are equalled nowhere else in the world.

A matter of importance is *Trade Marks in the American Republics*, which is a plea for the ratification of the Buenos Aires Convention of 1910

The Open Hearth versus the Electric Furnace in the Manufacture of Commercial Steel gives facts and figures of considerable value. An *Anemometric Paradox* describes a curious windmill that always turns the same way no matter how the wind blows, and it is illustrated by an explanatory diagram and photographs. *A High Efficiency Incandescent Lamp* describes the principles of operation, and the steps by which the lamp was developed. The valuable article on *The Structure of the Atom* is concluded. There is also an interesting variety of shorter articles.

Mixed Fuels Better Than Gasoline

COMPELLED by the exigencies of war to look around for substitutes for gasoline, in the operation of its huge fleet of army motor vehicles, Germany has reached at present a state of perfection in the adaptation of alcohol benzol mixtures, which a year ago seemed impossible. It has been known for several years that pure benzol, pure denatured alcohol or pure kerosene would not work well in internal combustion motors for automobiles, but the exact requirements in connection with the use of these fuels were not known, because none seemed impressed with the necessity for drastic action. When the war started and the importation of gasoline stopped, steps were being taken by the army authorities which promise to revolutionize automobiling in Germany

It is openly declared now that even after the war the majority of German motorists will continue to use certain alcohol benzol mixtures recommended after severe tests by the government During these tests many new facts were discovered in relation to the use of highly volatile and less volatile fuels, as were also the causes of former failures with alcohol mixtures, benzol kerosene and mixtures of these with gasoline The engineering department of the Imperial German transportation department has tabulated a series of experiments with various mixtures of the fuels mentioned their effective horse-power when compared with pure gasoline and the distances traveled with them, under the identical road and driving conditions accompanying the tests with gasoline

While, of course, many of the tests and the tabulated results are of merely theoretical value in the United States, and probably would not have created much interest even in Germany, had it not been for the extraordinary demand for motor fuels caused by the extensive use of motor vehicles in the army service—they are none the less interesting to Americans, because they show conclusively that gasoline is not by any means the best and most effective motor fuel for automobiles When compared with the work of certain mixtures of benzol and alcohol, gasoline must be considered both wasteful and expensive Pure gasoline of low volatility gives greater horse-power than is needed by the car, therefore it is wasteful and a gallon of it will not carry the car as far as a gallon of the alcohol benzol mixture

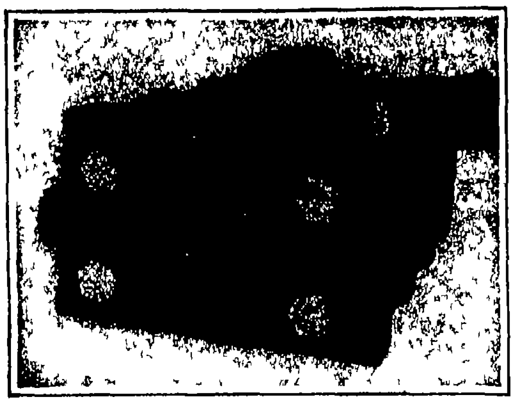
In the course of the experiments the tester used a medium powered Mercedes touring car, of the 1914 type, the carbureter of which *was set for ordinary gasoline* and not adjusted in any way during the series of tests. The highest speed obtained, and the distances covered on 1 litre of fuel are given in the following table

Fuel used	Speed attained km hr	Dist. traveled on one litre
1 part benzol with 1 part alcohol	68 km. hr	7 5 km.
1 part benzol with 2 parts alcohol	66 km. hr	7 2 km
1 part benzol with 3 parts alcohol	63 km hr	7 0 km
1 part benzol with 4 parts alcohol	62 km hr	6 6 km
1 part benzol with 5 parts alcohol	58 km hr	6 0 km.
Pure benzol	67 km hr	7 1 km
Pure gasoline.	70 km. hr	*5 8 km.

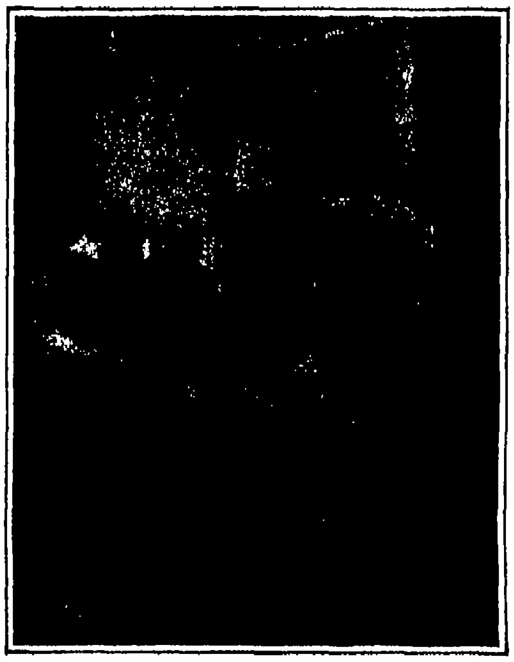
* Distance traveled on pure gasoline is 25% less than on the best benzol alcohol mixture, 1 1

When the cost of the fuel is taken into account, leaving aside all "war considerations" and counting only the prices of the fuels as they stood in Germany just previous to the outbreak of the war, the balance shows greatly in favor of the alcohol-benzol mixtures. Gasoline cost about 38 cents a gallon, benzol 37.5 cents and alcohol 34 cents. Taking these prices into account, as a basis for determining the cost of motoring the investigator discovered that he could travel 62 km for $1, if he used gasoline, 76 km, if he used pure benzol, and 84 km if he used the 1 1 mixture of alcohol and benzol. Strange to say, if the motorist had used pure denatured alcohol, without benzol, his expense would have been exactly the same as with pure gasoline, namely, 62 km. for $1.

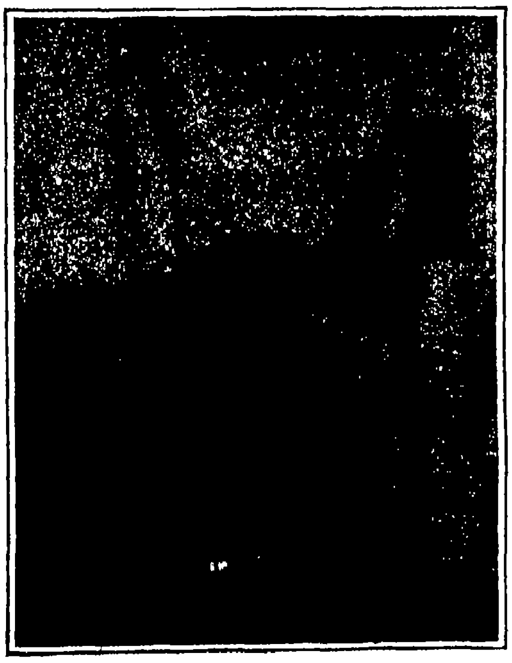
Such performances, not so long ago, would only have caused the motorist to point to the many supposed drawbacks attending the use of less volatile fuels, but the automobile motor of to-day has been improved so greatly that carburetion troubles are minimized. Furthermore, it was chiefly due to attempts to use *one* substitute (either benzol *or* alcohol) that carburetion troubles arose Benzol, if used alone, requires considerably more air for complete combustion than gasoline, and gasoline carbureters refused to work properly when called upon to handle benzol or alcohol On the other hand, alcohol can be compressed far more, requires less air and can stand greater heat without pre ignition than gasoline. Mixtures of alcohol and benzol, calculated so as to equalize the excess of air required by benzol with the excess of fuel required by alcohol, can be used in the ordinary gasoline carbureter without any adjustment whatsoever, as far as the air inlet is concerned. Such mixtures will not form any carbon deposits, not even in the oldest type of motors.



The cap and valve that seals the cell



Machine for filling the tubes of the positive plate with active material



Machine for making the fine horizontal saw cuts in the tubes of the positive plate

The greatest drawback to the use of benzol alcohol mixtures in automobile motors still remains the low volatility of the fuel and the necessity for pre-heating it, or for heating the motor itself It is very difficult to start a motor on the benzol alcohol mixture, and in the dangerous work which the motor cars are called upon to perform in the war this starting difficulty at first was a serious drawback The German army authorities realized this drawback, and every car was ordered fitted with a small auxiliary fuel tank, in protected position, in which fuels of high explosive force and low volatility are carried chiefly ether gasoline and benzene A three way cock connects this auxiliary tank with the carbureter When starting the motor, the auxiliary tank is connected but as soon as the motor has turned over a few hundred times, the gasoline or ether supply is shut off and the regular fuel tank is connected

The installation of the auxiliary tank, strange to say, was about the most successful innovation introduced by the German army authorities It is reported to have saved a large number of motor vehicles from capture by the enemy Nearly all gasoline tanks (that is to say the regular tanks) on German automobiles are fitted with pressure feed, and the moment a rifle bullet or shell fragment pierces the tank in its exposed position, the fuel supply is shut off automatically and the car has to stop But with an auxiliary tank the car may still be operated by simply turning the three way cock The driver is enabled to cover 10 or 15 miles without any difficulty bringing his car to safety, so that the installation of the "starting" tank has really worked out to even better advantage in providing also a reserve fuel supply for emergency cases

The general use of benzol alcohol mixtures by thousands of professional chauffeurs, drafted into army service, is certain to be felt in the field of motoring after the war is over Motor trucks even before the war have been operated to no small extent on benzol alcohol in Germany, and a strong propaganda is now being waged by the chauffeurs, the Imperial Automobile Club and the military authorities to extend further the use of such mixtures with gasoline starting tanks There is a strong probability that gasoline will be used to a less degree by motorists in Germany, than it was before the war Popular prejudices, based chiefly on limited knowledge and misinformation, have been conquered and the strong incentive of "patronizing the home industries" apparently makes it easy to stick to home made fuel, instead of returning to imported gasoline

Insects as Spore Carriers

AMONG the numerous diseases of various plants caused by parasitic fungi none are better known or have received more attention from scientists and the general public than the chestnut tree bark disease which has been recorded from all states in which the chestnut tree grows naturally The fungus causing this disease is called *Endothia parasitica*, which is killing millions of chestnut trees annually No efforts on the part of the state and federal authorities are spared in the way of preventing the spread of this disease wherever the presence of the fungus is detected It was supposed originally that the most frequent and rapid mode of spore dissemination was by wind wafting the spores from tree to tree and that a *good method of combating the disease was by cutting* and removing not only the diseased trees, but also those that stood close to them, especially those in the direction of the prevailing winds.

Although the amount of success depended very largely upon the thoroughness combined with an intelligent method of carrying out the work, it was soon learned that there must be means of spore dissemination other than by wind Plant pathologists observed during recent years that insects are directly responsible for the spread of certain plant diseases, and the Pennsylvania Chestnut Tree Blight Commission in cooperation with the Office of Forest Pathology, U S Bureau of Plant Industry, undertook to demonstrate experimentally whether insects carry spores of the blight fungus The result of the work conducted on this project by Mr R A Studhalter formerly of the U S Bureau of Plant Industry and Mr A G Ruggles of the Pennsylvania Blight Commission are published in *Bulletin 12 of the Pennsylvania Department of Forestry*

A careful study of the findings of the recent investigations dealing with the subject of insects as carriers of the spores of *Endothia parasitica* affords convincing evidence of a real connection between insects and this disease The only point in doubt now is to what extent the insects are responsible for the rapid spread of the disease Granted, at any rate that insects are responsible for a large share in the dissemination of the chestnut tree bark disease it must be allowed that the study carried on by the Commission is of the great est importance It gives strong support to the theory that the spread of other plant diseases are directly traceable to the action of insects

Feeling Through the Fog by Wireless

A New Means of Locating Vessels at Sea

By Robert G Skerrett

POSSIBLY it may not be quite exact to say that fog is as much of a menace to the navigator as ever but it is undoubtedly true that a formidable peril lurks in these visually impenetrable banks of mist There fore, both the seafarer and the water borne passenger have every reason to be interested in the invention of Otto Fricke an engineer and a former mariner

The cunning displayed in this new mechanism is two-fold It is a clever combination first of existing facil ties of established value, and then this union of forces, so to speak is made effective through mechanisms that provide a visible guide for the groping navigator The seafarer is accustomed to depend upon charts especially when piloting his craft in the neighborhood of the land Topographical features are permanent but a nearing ship, hidden by the fog while just as much of a danger as a submerged ledge or a jutting headland is however, on the move Therefore the thing most desired is that the man on the bridge may know just where this par ticular menace is and the speed and the direction in which it is advancing In brief what is wanted is a chart that changes at short intervals and carries a trace of the unseen vessel s course

To this end certain data are necessary First the distance off of the invisible craft that is underway, and next some check on her position at chosen inter vals of time this information serving to show both her path and the speed with which she moves onward Mr Fricke obtains this information by means of wire-less telegraphy and the lagging travel of sound sig nals the interval between the arrival of the two mes sages serving to establish the factor of distance with a reasonably accurate approximation We say approxi mation because it is a well known fact that interven ing strata of different temperatures affect somewhat the speed of transmission of sound waves through the air But this is not a serious handicap in the case of the field of usefulness of the present apparatus because absolute exactness at the start is not necessary in meas uring the interval between vessels several miles apart

The velocity with which wireless waves travel is such that their departure and arrival across a gap of 10 miles, let us say is for all practical purposes instan taneous While sound waves sent simultaneously with the wireless ones come along afterward seconds later By measuring the difference in time between the re ceipt of the wireless and the sound signals thus dis patched from a far-off ship it is possible to come pretty close to determining the remoteness of the sending craft The invention in question constitutes an ap paratus which in time of thick weather is continually on the alert and automatically responds to impulses of the character described and makes a graphic record or series of records, by means of which the navigator is both warned of the approach of another ship and shown just what he must do in order to steer a course that will carry him safely away from or past the other steaming vessel

Basicly the registering mechanism is operated by clockwork which is brought into play by wireless This machinery causes a series of radial belts—directed toward as many different parts of the entire horizon—to move uniformly outward from a common center That center represents the ship carrying the apparatus, and each of these belts bears two tinting points placed equidistant but only one of which is operable during its travel from the center to the rim Above these belts, which are disposed like the spokes of a wheel, is a translucent disk upon which is marked a series of con centric circles, and each zone typifies a mile The disk is of paper and removable, so that it can be filed away for record The method of functioning is as follows

Upon the arrival of the wireless dash' from the far off craft the clock work is released and all the belts start moving outward from the center taking with them their passive tinting points—passive because they leave no marks Seconds later comes the sound signal This is received by a telephone transmitter which, in its turn, closes a circuit which operates a relay The relay in its turn energizes a magnet located within the travel of the belt that happens to point in the particular direc tion of the source of sound This magnet acts upon a bit of iron on one end of each of the tinting points car ried by that belt attracts these lower ends, and in the case of the one on top brings its coloring tip up sharply against the under side of the translucent paper disk. Just where the mark is then made shows the direction as well as the distance off of the unseen craft that dis patched the operative signals The mechanism comes to a halt when the upper pen has reached the outermost limit of the belt, and, at the same time, the second tint ing point is ready for action at the central starting point.

Again a few minutes later the remote ship repeats the sending of her dual signals—wireless and sound, and once more the clock work functions, starting the belts rimward with their markers, and when the sound impulse arrives later the record is made—only that tinting point responding as before, which at that in stant points toward the fog hidden vessel Thus it goes on from time to time, and upon the paper disk are dotted the successive positions of the distant craft in relation to the vessel warned. First the tell tale dot is in the neighborhood of the outer zones, and gradually the succeeding dots come closer and closer as the two steamers draw nearer to each other It is understood, of course, that the idea is that all liners should be equipped with an outfit of this sort, and once two ves sels have established the fact of their proximity in this way they would alternate in sending signals and thus give each other a graphic story of their respective courses, distances, and speeds.

The direction determining part of the apparatus hinges upon the placing of the sound detectors at points around the ship s deck corresponding to the radial posi tions of the several pen carrying belts, and the tele phone transmitter or detector in any one of these posi tions controls only the tinting point of its associate belt To prevent operative confusion, each sound detec tor is blanketed by flanking walls so that it can receive sound impulses coming only from a limited sector of the horizon But should three of these mechanical ears pick up the signal—each making a mark on the disk the true direction would normally be the mean position, and the same would be the case should two of the detectors respond to the sound waves

Primarily, the apparatus is designed for service on the open sea or upon fairly expansive waterways where the signals would be exchanged over distances of some miles However should a number of vessels be con cerned they would alternate in sending their signals and this can be just as easily arranged in the case of the combined wireless and sound impulses as it is now commonly practiced in sending either of these signals Of course it is understood that the first purpose of the instrument is to pick up sounds that would not readily be detected by the ear, and in this manner to discover and to place a far-off ship, thus giving an ampler pe riod of warning—in effect a wider margin of safety

This same sound recording apparatus is equally capa ble of serving to detect icebergs or any other sound-reflecting body For this purpose the ship's whistle is blown before the wireless dash' is dispatched or the clock work can be released by hand immediately after the siren blast. As the sound has to travel to the re flecting surface of the hidden menace and then back to the telephone detectors the clock work is arranged then to run at half speed In this way the true distance of the iceberg or other menacing mass can be determined by means of the echo

The New York Motorboat Show

THOSE who had an opportunity to visit the Motor boat Show, which was held at the Palace last week, certainly had occasion to congratulate them selves for it undoubtedly presented the best collection of real boats, both in numbers and in variety of styles and models, that has ever been gathered together at one of these popular exhibitions. Almost every descrip tion of boat, from tiny rowing tender to lordly cruiser, which, with its silky black sides towered in the halls of the Palace like an ocean liner, was to be found, something to match every taste and every re quirement. One class, however which has been promi nently represented at most of the previous shows, was missing and this was the racer, for the racing machine of to-day has become such an expensive and formidable combination, three parts engine and one part boat that there are not very many craft in existence that can rightfully claim title to a place in the championship class, and there is little inducement to the builder of such a boat to exhibit his creations for the benefit of trade rivals.

The most diminutive boat in the show was an atom of a hydroplane that was about the size and shape of a shingle, but powered with a "V" type aeroplane engine it boasted of a speed of thirty five miles an hour Needles to say, it was a decidedly smooth-water affair A novel feature of this craft was the mounting of the rudder on a skeleton outrigger that extended several feet behind the wheel

Among the pleasure boats the smallest specimen shown was the homely little "jitney," a flat-bottomed skiff model, with the wheel located in a rectangular stern tunnel, and a little motor stowed away in a sort of vest-pocket compartment amidship. Starting from this lower extreme the line extended upward through a delightful series of graceful runabouts in mahogany and teak to the lordly 60-foot cruiser above mentioned, which was finished in elaborate de tail and luxury and powerful enough to sail on any sea. Two splendid lifeboats were also shown, im pressive on account of their sturdy construction and powerful models, one of which was fitted with a motor located within a water tight housing amidship.

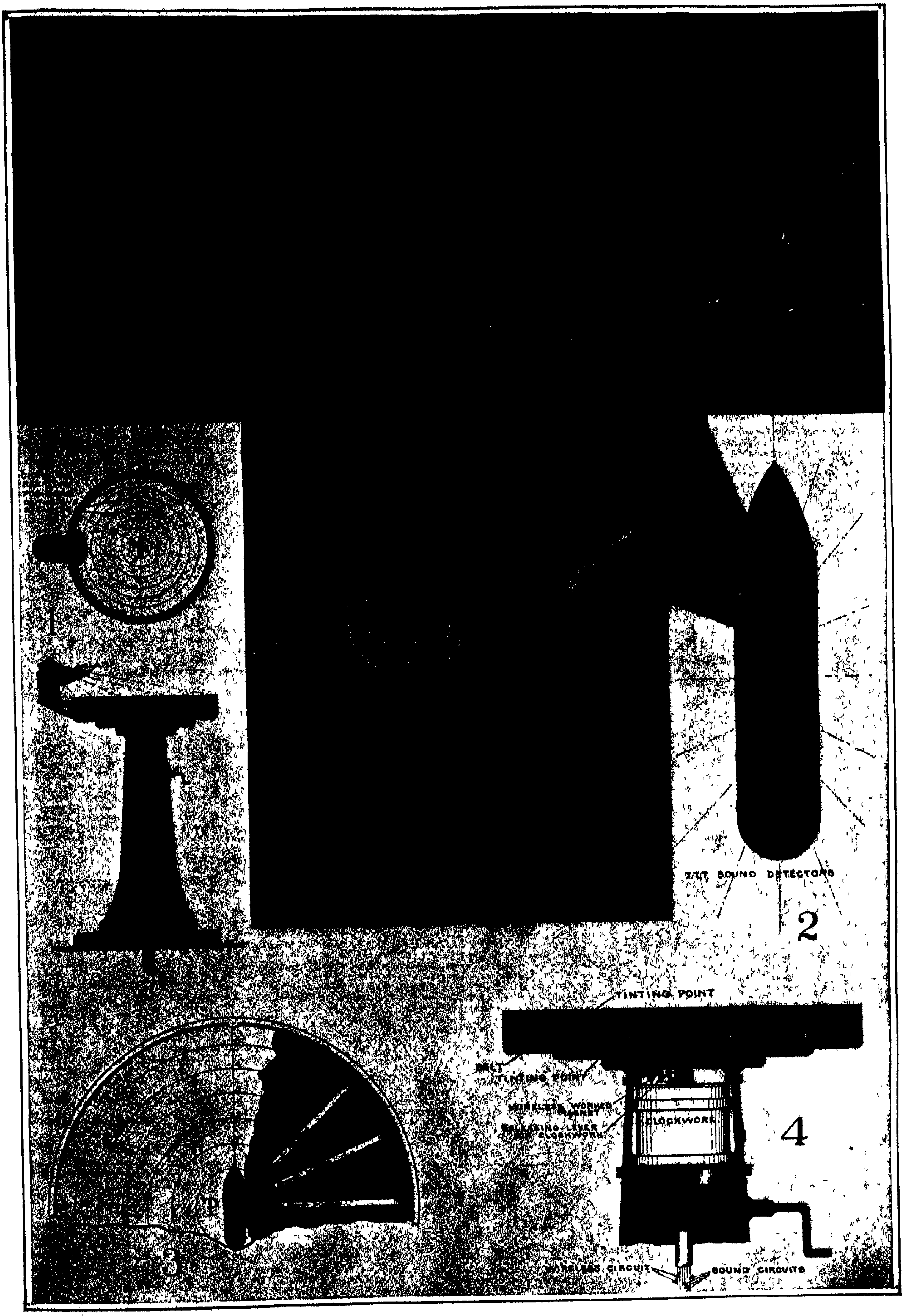
Cruisers having complete living accommodations are growing in popularity, and the competitions instituted by various associations, first as tests of reliability and seagoing qualities, have developed into speed contests as well, and one of the large boats shown has achieved quite a reputation in this direction. This craft is of the now popular "V" bottom type, a method of con struction that is being widely adopted, and there were several handsome specimens of this type shown, but the older round bottom, or displacement model, still holds its own, as is evidenced by the number of hand-some and speedy runabouts seen in the exhibition, and these formed attractive pictures with their immacu lately polished hulls, gleaming metal work and lux urious passenger accommodations.

While the finished boats were the most prominent features of the show, the exhibition of engines was equally important and interesting, and a striking fea ture of the exhibits was the almost universal practice of inclosing all working parts This method of design makes the motor so cleanly that the owner-operator is not now compelled to don overalls when going out for an afternoon run, and the smooth enameled casings add greatly to the tidiness and attractiveness of any craft In every direction there was evidence of un usual attention having been given to refinement in both design and workmanship and the comparison between the engines of to-day and those of five years ago is most striking This refinement is the most prominent feature of the motors shown but there are a few notable novelties one in particular being a new 'ex press ' model, specially designed for use in the fast cruiser, which is becoming so popular, or in the speedy runabout In such craft high power in a compact form is required, and the engine must necessarily run at high speeds for considerable periods of time In the past such engines were difficult to operate because of the liability of the bearings to heat, and the watch ful attention of an expert was necessary to avoid a breakdown In the engine in question, in addition to bearings of a liberal size, a forced feed system of lubrication is introduced which insures that all bear ings are constantly flooded with oil The surplus oil, together with that which has flowed over the bear ings, passes to the base and is utilized to lubricate the wrist pin and pistons by the splash, but the notable feature is the water jacketing of the lower part of the base which thoroughly cools the oil before it returns to the pump to be circulated again This not only maintains the oil in better condition, but insures a double cooling of the fast moving shafts and pins. An other novelty was a two-cycle motor which was pro vided with pumps that drew the mixture from the carbureter and forced it into the cylinder, thus insur ing more perfect scavenging and a fuller charge than is attained by the ordinary system of base compression

There was one Diesel type engine, suitable for yacht work, and several oil engines of the hot bulb type, espe cially designed for heavy duty in commercial vessels, and these were well worthy of careful study, as the use of internal combustion motors in working boats, in place of steam, is rapidly becoming of greater im portance. Indeed, if the price of gasoline continues to increase, we may expect another year to see motors of this type offered for use in pleasure craft. It is certainly a question that has so far received too little attention from builders generally

An attractive assortment of accessories was shown, to me every requirement of the motorboatman, but the star feature of this department was the gyro ship stabilizer, which was shown in actual operation, at tached to a model section of a boat which, by an in genious mechanism, was caused to roll in a very natural and suggestive manner The attachment here shown, which would be suitable for a craft of about three tons displacement, was very compact, and its control over the movements of the boat is one of the marvels of modern science.

Spaces were occupied by the New York Naval Re serve, the Junior Naval Reserve and the New York Nautical College, where displays of an educational character added variety to a notable exhibition.



FEELING THROUGH THE FOG BY WIRELESS A PHOTOGRAPH OF THE INVENTOR IS SHOWN IN THE MIDDLE OF THE PAGE

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the Scientific American.

Pertaining to Apparel

ADJUSTING DEVICE—W DEUTSCH, 688 Broadway, New York, N Y The invention relates to trousers, vests suspenders, garters, hose supporters and like articles, and provides a device arranged to permit convenient adjustment of the article with a view to shorten or lengthen the same or to adjust a portion thereof between spaced points

Pertaining to Aviation

STABILIZER FOR AEROPLANES—A B THAW, 640 Park Ave, Pittsburgh, Pa The invention provides an apparatus operable both manually and mechanically provides means automatically adjustable for regulating the angle of stability provides means for varying the angle of stability coincident with the operation of the steering and equilibrating mechanism provides means for manually setting the automatic stabilizing mechanism without limiting the operation of the same provides an automatic mechanism adapted to operate at the beginning of movement from the adjusted plane of stability, and provides means for inaugurating the operation of the stabilizing mechanism

Of Interest to Farmers

GRAIN CONDITIONING AND TEMPERING MACHINE—W S BARKER, Box 55, Auburn Ky In the present patent the invention has reference to improvements in means for treating grain previous to milling and has for an object the provision of an improved structure through which grain may pass for conditioning and tempering to any desired extent

TRANSPLANTER—C T PELTON, Fallon Nev This invention provides a strong and inexpensive plant box wherein a large number of seeds can be expeditiously planted and will be held during germination and after sprouting, without danger of the roots of the various plants becoming tangled

Of General Interest

MOLD CLAMP—W BENDER, 13 Grove St., Winfield, L I, N Y This invention relates to molds for forming concrete columns and similar structures The aim is to provide a mold clamp which is simple and durable in construction and can be easily applied for securely holding the mold sides in position against spreading

TOY SAVINGS BANK—C A HILL, 334 W 53rd St., New York N Y This inventor provides a savings bank arranged to permit of conveniently introducing coins of different denominations to prevent surreptitious abstraction of the accumulated coins and to allow of conveniently opening the bank at the time the same is filled with coins

Hardware and Tools

KNIFE—W R BROWN Union Cutlery Co., Olean, N Y An object of this invention is to provide a lock actuated by the usual spring of the knife for engagement with the blade of the knife and a disengaging lever for throwing out of operation the spring in order to allow the blade to freely swing for permitting a ready closing thereof

SELF LOCKING SAFETY CATCH FOR HAND BAGS—G H GENTZEL, 1231 Park Ave Hoboken, N J The invention has particular reference to temporary fasteners for holding the jaws of a handbag shut It provides a means of a simple cheap and reliable nature adapted to prevent a surreptitious opening of a hand bag by means such as would ordinarily accomplish such result on handbags equipped with fasteners as ordinarily made

Machines and Mechanical Devices

AUTOMATON SIGN—R. J SCHUHMANN, 4823 South 3rd St, Louisville, Ky This improvement provides a sign with power means for moving a section thereof in simulation of the action of a living figure provides a power means for the purpose set forth operable in correspondence with the motion of a vehicle by which the sign is carried and simplifies the mechanism of said power means.

GATE VALVE—R. J RILEY, Livermore Falls, Maine. This invention refers to gate valves of low pressure mainly used for controlling the flow of semi fluid substances or diluted paste materials such as paper pulp or any other similar substances It provides a valve which can be easily and quickly cleaned so as to facilitate the closing or complete opening of the valve no matter in what position the gate or the valve may be

INDICATING DEVICE—J W FRITCH and DELIA E HOOPES Address Mrs Della E. Hoopes, 1406 Meridian Place N W, Washington D C The invention is designed to be used in connection with other machines, such as punching or tabulating machines, and the main object is to provide a device by means of which one can ascertain whether a certain key which he desires to operate has, as a matter of fact, really been operated.

Medical Instruments

THERMOMETER—F S. DICKINSON, care of Becton, Dickinson Co Rutherford, N J The invention provides means whereby the mercurial column or thread of the clinical thermometer may be quickly and conveniently shaken down or lowered without liability of breakage such as is liable to occur in such thermometers as ordinarily constructed, and improves and simplifies the construction of the carrying case or sheath so as to lessen the liability of loss or misplacement of the parts thereof and to facilitate the introduction and removal of the thermometer therefrom.

Prime Movers and Their Accessories

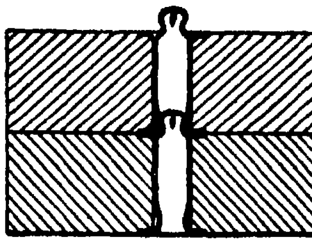
ENGINE CONTROL—L J CRAWFORD, Electra, Tex. This invention relates to engine controls, and has reference more particularly to means for controlling an internal combustion engine which is adapted to prevent fuel combustion when the power-transmitting element, for any reason, has interrupted the transmission of energy

Railways and Their Accessories

DOOR.—W O THORP, Brainerd, Minn. This invention provides a door for use as a grain door in freight cars, wherein the door is sectional, and the sections are movable with respect to each other to provide for various widths of door openings, and wherein each section has means at its outer end for engaging the sides of the door opening to prevent lateral movement of the door, and wherein means is provided for moving the sections and for holding them in adjusted position.

Pertaining to Recreation

CHECKER—J F HODGES, 1315 Chapline St., Wheeling, W Va. The object of this invention is to provide means for securing one checker or game piece on another when the latter is crowned and to prevent the separation of the pieces by casual movement or otherwise and also to facilitate handling of the same This is produced by having a metallic



CHECKER OR GAME PIECE.

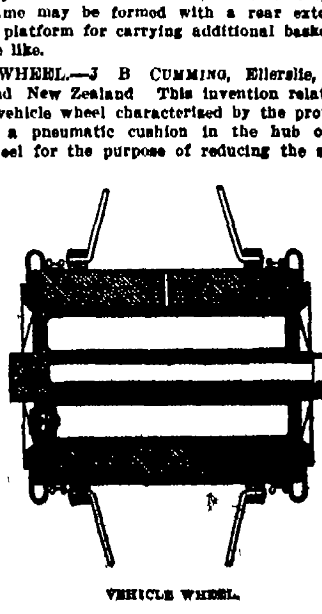
tubular element run through the center of each checker, the tubular element being provided with clip flanges which engage opposite sides of the piece the tubular element being provided with a projecting snap device at one end and a socket to receive a corresponding snap device of another checker at the other end.

SPOON—J A SEBENIUS Shelton, Wash The invention provides a spoon for trolling that closely simulates the action of a fish, while being trailed through the water and the spoon of sheet metal is provided with a propeller for rotating the same as it is drawn through the water, the sheet metal being so shaped that the rotation of the spoon will present the outline of a fish and the spoon is provided with a bait hook connected to the spoon by a leader the spoon being connected to the line and the hook so that the rotation thereof will not interfere with the line or the hook

Pertaining to Vehicles

DELIVERY TRICYCLE—W A BARNES, 21 104th St, Seaside, Rockaway Beach, L. I, New York, N Y This invention provides a tricycle having a novel frame structure whereby a flat platform for carrying baskets and the like is arranged in front of the steering post and between the latter and steering wheel such platform having means whereby a plurality of baskets can be detachably locked thereto and, furthermore, the frame may be formed with a rear extension or platform for carrying additional baskets or the like.

WHEEL.—J B CUMMING, Ellerslie, Auckland New Zealand This invention relates to a vehicle wheel characterized by the provision of a pneumatic cushion in the hub of the wheel for the purpose of reducing the shocks



VEHICLE WHEEL.

and vibration due to the weight applied to the wheel during the movement of the load on the wheel. It provides a pneumatic wheel in which the parts subjected to wear are so positioned that they can be easily and quickly inspected and replaced.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Industrial Preparedness for Peace

(Concluded from page 177)

of coal tar colors. Of this amount 3,300 tons were made in the United States, from semi-manufactured material imported chiefly from Germany We imported 25,700 tons of artificial dyes from Europe—22,000 coming from Germany To-day twelve American companies—six organized in the course of 1915—are manufacturing artificial colors at the annual rate of 18,000 tons

There is a confident expectation that 1917 will see the bulk of the coal tar colors, used in our diverse industries, made in our own factories from American raw material

Never before in our own or any other country, has so complex and intricate an industry been organized and created in such a short time! It is inspiring in its revelation of what American pluck and energy can accomplish when put upon their mettle!

There remain two more fields—two still greater fields—in which these characteristics of the American technical chemist must make themselves felt and that right promptly

Potash is an indispensable constituent in the food ration of our crops and a variety of its salts is required in medicine and the arts Our annual supply valued at nearly $17,000,000, is derived entirely from the German mines of Stassfurt

In our unlimited veins of feldspar, in the vast deposits of Utah alunite in the brine of various western lakes, in the kelp of our western littoral we have natural sources of potash ready to respond to intelligent and organized activity on a grand scale The kelp of our Pacific coast, alone offers an annual harvest worth at ante bellum rates $90 000 000

Of still greater importance for agriculture for the arts and notably for military preparedness is the factor of nitrogen We send abroad annually $30 000 000 for nitrogenous material $17 000 000 going to Chile Civilized life is unthinkable, national defense against invasion impossible without an adequate supply of nitrogen in a combined form The complete conquest of the air, the industrial transmutation of the invisible medium in which we live and breathe, into the hand maid of American industry is the grand problem now confronting our nation's chemists

I have passed in rapid review and in a somewhat cursory and summary manner the more salient features which mark the mighty industrial revolution moving on swiftly but almost silently about us

Its consummation is inevitable A year or two hence should witness the entire cycle of industries, needed to make our national life well rounded and complete adequately established and permanently rooted in American soil

A few years later should witness our ability to not only meet the country s needs in scores of branches for the products of which we have hitherto depended upon European brain and brawn, but to boldly sally forth into the world's markets, and meet on even terms the present dominating factors

What has been accomplished with the products of our iron mines and our pine forests as well as with the many triumphs of American mechanical genius can surely be achieved in the remaining fields of technical effort by a similar use of resoluteness and energy—after all, the greatest of our national assets!

NOTE—The SCIENTIFIC AMERICAN published in the last issue a complete study of the existing potash famine and of the means available for establishing a complete independent potash industry in our country later a similar study will appear on the outlook for the creation of an American nitrate industry

NEW BOOKS, ETC.

THOMAS ALVA EDISON By Francis Rolt-Wheeler New York, The Macmillan Company 1915 12mo, 201 pp, illustrated Price, 50 cents.

This short but authentic biography of Edison is a splendid book to place in the hands of a boy If he is old enough to read at all, he is old enough to enjoy its anecdotes of the youth and manhood of our American Wizard. Underlying the whole account of early struggle and final victory is a lesson in moral principles that is none the less forcible for being so unobtrusive.

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The Plane Theory Exposed. Compiled by David Nield Published by the Author, Wellington, N Z. Price, 1d.
Eden's Initial Day Line. By David Nield. Willington, N Z.

The first of these tracts presents proofs of the earth s sphericity The second urges from a religious standpoint, that the march of the days be held to commence at Lake Van in Armenia, instead of at a point in the Pacific Ocean Mr Nield is thus assuming of course that Lake Van marks the site of Eden, the birthplace of mankind

Business Directory of the Manufacturers and Dealers League. 1915 Office, 2625 Grand Central Terminal, New York

This directory, issued by The Manufacturers and Dealers League of the City and State of New York gives its officers and directors classifies firms according to the nature of their business and appends an alphabetical list of its members

Men of the Old Stone Age. Their Environment Life and Art By Henry Field Osborn Sc D LL D Curator Emeritus of Vertebrate Palaeontology in the American Museum of Natural History New York Charles Scribner's Sons 1915 8vo, 545 pp illustrated Price, $5 net

The author is to be congratulated upon the unique opportunities afforded him by his 'Palaeolithic tour under the guidance of such distinguished archaeologists as *Emile Cartailhac*, Henri Breuil and Hugo Obermaier and *the reading public is to be congratulated* in that this opportunity fell to the lot of a man so well equipped to absorb its wealth of knowledge and suggestion and to translate significant facts and findings into our everyday language His introduction shows how closely the Greek conceptions of man s origin conformed to modern theories it follows the rise of anthropology traces geographic and climatic changes and deals with the migrations of mammals In the main body of the work the *Java ape man, the Heidelberg and Piltdown* discoveries, the Neanderthal race the Grimaldi skeletons, and the Crô Magnon remains are severally discussed in a series of most fascinating papers The environments and industries of these early men are restored for us by the skilled pens of writer and artist and the art of the cave man is placed before us in all its original lines and colors Maps and charts abound and there is a folding insert showing the region traversed by the author in his motor tour through the Palaeolithic caverns of Italy France and Spain

Painting by Immersion and by Compressed Air. By Arthur Seymour Jennings F I R D New York Spon & Chamberlain 1915 8vo 272 pp 150 illustrations Price $3 50 net

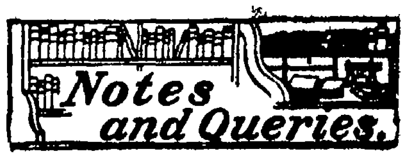
In numerous cases and under a wide range of conditions the application of paint by dipping or spraying has proved to be superior to brush work in time saving in thoroughness, and in durability An instance of the time saved on particular work is that of enameling the body of a small touring car by the "flowing on process, a complete coat is applied in two minutes The various modes of painting by im*mersion* with the kinds of paint called for and the requirements of different trades are de*scribed by the work in hand Spraying by the* use of compressed air is discussed at length and the hundred and fifty illustrations show plants, methods and machinery in the fullest detail

Modes of Research in Genetics By Raymond Pearl Biologist of the Maine Agricultural Experiment Station 8vo 182 pp Price, $1 25

These papers critically examine current modes *of research* in what is a comparatively new field of biological study This promising territory touches upon zoölogy at one point and botany at another, and both the laboratory and the agricultural experiment station are exploring its possibilities The new methods which this new study has evolved embracing as they must, chemistry physics and mathematics, certainly call for as clear an explanation as can be given the student and this is exactly what the ordinary biometric treatise palpably lacks. Mr Pearl s text is an excellent introduction to the study of genetics, and is both stimulating and formative

Huron and Wyandot Mythology No 11, Anthropological Series, Memoir 80 By C M Barbeau Ottawa Government Printing Bureau 1915 8vo 446 pp illustrated

The oral narratives of the American aboriginal come under several more or less distinct types. He frequently distinguishes between the true and the imaginary narrative the Hurons and the Wyandots have traditional tales, or those which deal with myths in general, and "They went to-hunt for meat tales, which bear upon guardian spirits or monsters In Mr Barbeau s valuable compilation the Huron Wyandot mythology is tentatively summarised their cosmogonic and sociological beliefs are given in much detail folk tales are presented, and other traditions and anecdotes which do not come under the preceding classifications are cited There is also an admirable series of photographs of the individuals through whom these stories were secured The volume embodies an arduous labor of love, and has its appeal to the general reader as well as to the anthropologist.



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(14045) W H H asks Is the principle of the thermos bottle in the vacuum between the inner and outer shells? Is it the vacuum that prevents the heat from passing from the inner to the outer shell, thereby retaining the heat in the liquid in the bottle? The outer shell is cold when the hot liquids are placed and kept in the bottle and remains so (or vice versa for cold liquids) Does the mercury lining on the inside of the outer shell and outside of the inner shell have anything to do with this? Would a bottle constructed on identically the same principle of clear glass (omitting the mercury linings) answer the same purpose as one mercury lined? A The thermos bottle is described in Lynde's Physics of the Household with a cut showing its construction We send the book for $1 40 post paid It is a modification of the Dewar Bulb in which liquid air can be kept for quite a time It depends upon the fact that heat of low intensity, and great wave length cannot pass easily through a vacuum To increase its ability to retain heat or keep it out as required, the surfaces of the glass inside the outer coating and outside the inner are coated with silver which acts as a reflector for the heat Mercury is not used upon the lining of the bottles Silver is used and the bottle would not act so well without it

(14046) R. F asks Can you oblige the writer with information as to where he may obtain certain scientific facts along the lines *of the following list? It is likely that this* may have been contained in some of your recent publications Thanking you in advance for this for which enclosed find stamped reply envelope 1 A general outline of the history scope and origination of the Krupp Steel Works of Germany including their size power etc 2 An article that will include a sketch of great American inventions and great American inventors 3 Information as to wireless telegraph as to whether it is considered an American invention or not 4 Confirmation of a statement that the following inventions can be considered strictly American 1st—Cotton Gin 2nd—Steamboat 3rd—Locomotive 4th—Electric Light 5th—Telegraph 6th—Telephone, 7th—Phonograph 8th—Wireless Telegraph 9th—Aeroplane, 10th—Wireless Telephone, 11th—Moving Picture A 1 It is doubtful if such information as you seek concerning the Krupp Works in Germany can be obtained 2. Sketches of inventors and inventions will be found in any good Encyclopedia especially in the Encyclopedia Britannica both of American and those of other nations. You will find most valuable aid in this direction from our book, 'Byrn's Progress on Inventions in the Nineteenth Century' which is now out of print 3 The first successful wireless telegraph was invented by Marconi an Italian 4 The inventions you name were not invented in any one country They were as follows Cotton Gin, Whitney, American, Steamboat, English and American, the earliest were English, Locomotive, English Stephenson, Electric Light, Davy, English 1809 After the dynamo came many inventors in America and Europe, Telegraph, Morse American, invented the dot and dash alphabet, and the automatic register which made the work practical Telephone, the first by Reis, German The final practical speaking telephone, Bell American Phonograph, Edison, American Wireless Telegraph, Marconi Italian Aeroplane Wrights, American, Wireless Telephone not yet completed, Moving Picture, Edison American You can get full details from any library and you have a most excellent library within walking distance of your home at Pratt Institute, Brooklyn, where the attendants are most willing to afford you all the assistance in their power to obtain information

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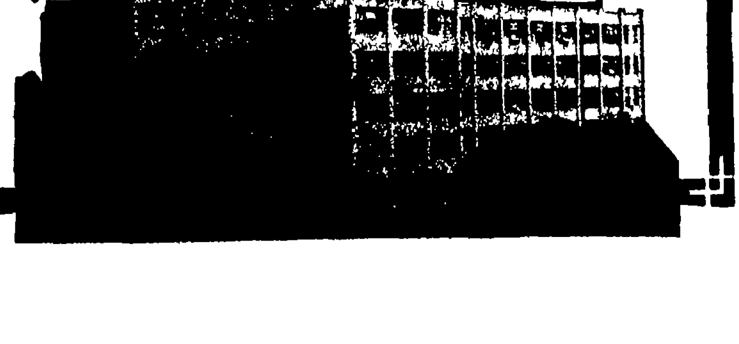

SCIENTIFIC AMERICAN

AUSTRIAN GUN IN A TUNNEL PIERCED THROUGH AN ALPINE CRAG [See page 198]

February 19, 1916

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV.] NUMBER 8 | NEW YORK, FEBRUARY 19, 1916 | [10 CENTS A COPY $3.00 A YEAR

Displacement, 27,500 tons. *Length,* 583 feet overall *Beam,* 95 feet. *Speed* 21 knots *Guns* ten 14-inch twenty-one 5-inch *Torpedo tubes* four 21 inch

The "Nevada" and "Oklahoma" class of superdreadnoughts

Our Latest Superdreadnoughts

WITH the completion of the preliminary Government trials of the superdreadnoughts "Nevada" and "Oklahoma," the time of their acceptance by the Government and incorporation, as the most important units in our national naval defense is at hand

It is difficult to realize, in the rapid progress of naval development, that vessels of this type have relegated to the second line of battle all except eight of the battleships of this country now in service, and that when commissioned they will increase the effectiveness of the first line of defense by considerably more than 25 per cent.

The first notable improvement in the "Nevada" over the preceding types is to be found in the concentration of the main battery in the ideal four turret arrangement, by installing three guns abreast in each of the lower turrets. The "Nevada" is the first to have the three-gun turret. However, this has now been exceeded by the four gun abreast turrets of the French After it had been demonstrated that turret guns could be fired directly over other turrets and guns without injury to the personnel or equipment of the lower turret the question of disposing the main battery on the center line was definitely settled However, the limit of ability to mount and operate the main battery guns (except in the case of the superposed turrets in "Kearsage" and "Rhode Island" classes of predreadnoughts) was considered to be two guns abreast. With the adoption of the four turret arrangement permitted by the three-gun turret, the forward and the after fire have been improved 50 per cent and the control and concentration of fire is better Where the discharge of the three guns from one turret occurs as in the salvo pictured in our illustration, the dispersion of these shots may be expected to be less than that to be anticipated as between guns in different turrets. The practically simultaneous impact on a small area of target of a successful discharge gives a hitting power much superior to that which would otherwise be obtained

One is struck by the single smoke pipe on a vessel of this size and power but it is a logical development of giving the maximum protection to any element of the ship requiring protection It is rendered possible by the compact arrangement of boiler power permitted by the use of fuel oil The "Nevada" is the first dreadnought for which oil is the exclusive fuel This gives great advantages to the ship in the case of receiving the fuel on board The officers and crew will view the passing of that grimy and strenuous operation of "coaling ship" with equanimity The coal passer disappears and the fireman's most arduous labor will be the adjusting of valves and nozzles While cleanliness will be promoted and labor reduced, and the problem of fuel storage simplified yet coal well disposed affords a certain amount of protection to vital parts in a ship Also coal is a commodity found for sale in sufficient quantities for bunkering purposes in all parts of the world Accordingly to take full advantage of this change it will be necessary to establish oil depots and to make use of oil tank ships.

The improvements in each succeeding type of dreadnought commissioned are the more impressive because fairly obvious, from casual view, to the average observer

The recent discussion on the floor of the House of Representatives asked for the standardization of design for battleships after arriving at the best ship for the purpose This is not such an unreasonable demand as might appear Indeed, it is a contest between waiting for a superior ship or getting much sooner a very good ship Heretofore this contest has been settled and properly, in favor of the superior ship Should the emergency become sufficiently acute, the time required to build could easily become the predominant factor The best ship for the purpose known at the time of authorization of a program of construction is the last completed design.

The time allowed for the development of the design of the "Nevada" has resulted in the production of a ship very much superior in every respect save speed to the first dreadnoughts built for this country as the comparative table of their main characteristics shows

	"Nevada"	1st Dreadnought
Length overall	583 ft	510 ft
Beam	95 ft 2½ in	85 ft 2½ in
Normal draft	28 ft 6 in	26 ft 11 in
Displacement	27 500	20 000
Horse-power	26 500	29 500
Speed	21	21
Guns	10 14 inch	10 12 inch
	21 5 inch	14 5 inch
Torpedo tubes	4	2

The notable increase in size of the "Nevada" over the first of our dreadnoughts (the "Delaware" class) has not marked the only advance attained as improved design has contributed its quota The improvements in the form of the ship the reduced boiler power required to attain the desired speed and the less weight of the new fuel required are all elements giving additional effective displacement displacement which is consumed in additional gun power or for defense against the same, and to take care of the new and dangerous developments in underwater warfare While the ability to strike many blows and strike hard is the popular measure of success for the "Nevada" yet the most notable achievement of our designers has been in giving the fullest measure of protection by armor and subdivision to every really vital part This renders the ship capable of receiving great punishment without diminishing her effective attack

Altogether the "Nevada" forms a very satisfactory and welcome addition to our battlefleet, and brings forward in a striking manner the large value of single units among the latest capital ships.

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway,

New York, Saturday, February 19, 1916

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Another Naval Invention!

WHATEVER else may be said of the effects of the European war on American life, one of the outstanding features thus far has been the numerous inventions of a military nature appearing from time to time in the daily press. And of all fields of exploitation for questionable, untried inventions, none has been so fertile as the Sunday magazine section of the metropolitan newspapers. This is readily accounted for; newspapermen are seldom technical men and anything that is of a spectacular nature, whether it sounds feasible or not, soon finds its way into the columns of the newspapers.

The most recent instance of an ambitious invention intended to revolutionize present modes of warfare is in the form of a number of "pancake" coils bolted to the sides of a warship so as to render it immune from torpedoes. According to its inventor, a New Yorker, if an iron or steel rod is brought in the vicinity of a powerful electromagnet it will take a position at right angles to the axis of the electromagnet winding. Basing his invention on that principle, he proposes placing a number of electromagnets along the sides of a vessel so that torpedoes aimed at a warship thus equipped will be deflected from their course when within effective range of the magnetic fields set up in the water by the "pancake" coils. Evidently the inventor does not mean pancake coils as this term is generally understood, since his diagrams show the coils to be wound in the form of solenoids parallel to the ship's hull.

That the scheme proposed is a most ambitious one cannot be denied. But how impracticable! In the first place, a bar of iron or steel does not necessarily assume a position parallel to an electromagnet, when brought within its field of influence. Quite the contrary. If the bar is of a small size as compared with the electromagnet it will be attracted end on toward either pole of the solenoid. But if the bar is magnetized and in size compares favorably with the electromagnet, it may then assume a parallel position. Still it is rather doubtful that an enemy bent on torpedoing a warship will be so courteous as to magnetize his torpedoes in order that they may be ineffectual.

Overlooking what appears to be a misunderstanding of the principles of magnetism by the inventor, the next question is that of supplying a current sufficiently powerful to energize the "pancake" coils. Anyone familiar with electromagnets is fully aware of the limited extent of a magnetic field, no matter how powerful it may be. Even with the most powerful current passing through the "pancake" coils—and it must be taken for granted that the necessary electric power even if it ran up into hundreds of kilowatts would be available and devoted to such a valuable end—it is absurd to believe that the magnetic field would extend sufficiently to deflect a torpedo coming head on towards the hull of the warship at a speed of perhaps 40 miles an hour. And as a further consideration the nearby steel hull of the ship would practically short circuit the magnetic field.

Finally, supposing for the sake of further argument that the proposed anti-torpedo system was effectual against torpedoes, what would be its effect in relation to mines which, as the naval losses of the war have taught, are plentifully scattered even on the high seas? A mine is certainly anything but a torpedo-shaped object and hence the principle of parallel alinement which the inventor has discovered would here fail to be effective. Instead may we not suppose that the "pancake" coils would have the effect of drawing contact mines against the sides of the warship, thus courting self destruction?

It is indeed unfortunate that ideas of this category find their way into the daily press, for the non-technical public is soon deceived into believing that in time of war our country could even with inferior equipment and personnel meet and defeat a superior enemy because of the resourcefulness of such inventors.

Modern Firearms

THE commonest injuries produced in war are gunshot wounds. Until fifty years ago a soldier's musket carried only about 835 feet, and this degree of efficiency had not been exceeded for more than two hundred years, i. e., from 1640 to 1850. In other words the wars of Louis XIV, the struggles of the French Revolution, the Napoleonic Wars, the Crimean War and our War of 1812 were all fought with firearms which had no effect at a distance greater than 835 feet. In 1857, however, the smooth bore gun barrel was replaced by the rifled barrel, and this change caused an immediate increase in the carrying distance to 2,000 feet. At the time this result seemed to the whole world nothing short of a miracle, but as early as 1866 a French officer, Chassepot by name, invented a rifle having a calibre of 15 millimeters which carried 4,000 feet. Ten years before, this accomplishment would have seemed quite impossible. On November 4, 1867, the new Chassepot rifle was submitted to a practical test. The French sent a detachment of men to occupy Rome, and to hold it against the advancement of Garibaldi. The effect of the new rifle in the engagements was so remarkable that the entire French army was immediately equipped with Chassepots.

The Chassepot rifle weighed nine pounds and the Gras rifle which was introduced in 1874, weighed nearly as much but it had a carrying distance of 6,000 feet. After remaining the same for 217 years the carrying distance of firearms was thus increased in 15 years by 5,165 feet. At the same time the firearms of the Austrians, Prussians and Italians were also greatly improved and a repeating rifle firing 16 shots a minute and having a carrying distance of 9,000 feet came into practical use.

The rifles in use to-day are much lighter, are more easily handled and carry a distance of more than 12,000 feet at the rate of 2,700 feet per second. The revolver was first introduced in 1850, since then it has also undergone great improvement. Its carrying distance which at first was only about 100 feet was increased to 330 feet, then 680 and finally 4,000 feet.

In comparison with such means of defense and offense it is interesting to call to mind the weapons of the ancients. A javelin could be thrown about 84 feet, the sling ordinarily hurled its missile 266 feet, the Balearic slingmen being famous however because they could hurl a stone 433 feet. The wooden bow was in use until the middle of the 15th century, by means of it an arrow could be propelled a distance of 265-330 feet, while the steel crossbow which came into use later carried from 330-340 feet. The old blunderbuss of the Pilgrims which was supported on a fork was effective for about 500 feet. The early musket carried about 600 feet. This firearm was much improved so that it could shoot a distance of 835 feet and this was the best the world knew until 1857.

Have We Advanced?

SOMEBODY once wrote a book with the title "Civilization, Its Cause and Cure." The title is an attractive one and expresses in a neat manner a not uncommon viewpoint. A distinguished English engineer once remarked that if we cannot have modern civilization without having such darksome festering patches as Manchester and some other English industrial towns, then the world would do well to dispense with civilization. And readers of G. K. Chesterton will remember how fiercely that gentleman combats the whole idea of "Progress." He insists that Progress is a relative term and seems to consider that we moderns are, on the whole, progressing towards Hell rather than towards Heaven. It is unnecessary to point out that many religious teachers are of the same opinion.

Yet there is another view for which something can be said, and by comparing the two we can reach a clearer idea of the validity of either. In spite of the existence of towns like Manchester and Pittsburgh, in spite of slums and sweated labor, and in spite of the war, we are now, in some very valuable respects, better off than our fathers. The valuable features of modern progress may be summed up briefly by saying that there is a greater amount of constructive thought in the world at the present time than there ever was before. Problems of all kinds, social, political and economic, which before were barely touched on, are now handled with breadth and thoroughness. The creation of the ideal world wide state that men have dreamt about since the days of Plato is now nearer to being an intellectual possibility than ever before. We say "intellectual" possibility and that indicates at once the strength and the weakness of our progress. For while, as a scheme this great conception of a world state can really point to some advancement, the primitive passions and lusts of mankind seem more terribly permanent than the hardest granite. By the work of scientific men and thinkers of all kinds, we have come near to making Universal Brotherhood a feasible project and then, just before the final touches are given to the theory, mankind sallies forth in its millions bent on mutual destruction.

It is apparent that the unquestionable intellectual advance which has taken place is altogether too localized. A certain small section of mankind has carried science and speculation in general to a point never before reached, has opened to the world mightier and more magnificent vistas than ever dawned upon the most gifted men of the ancient world; but on the other hand our newspapers, our picture shows, the current amusements of the people, almost indicate a greater intellectual degradation than has previously existed in written history. Which of these two is the real tendency of the modern world? Suppose, on the one hand, we consider—say the "History of the Science of Physics" and on the other "The Rise of the Modern Politician" and then try to decide which way things in general are going. Are things in general going anywhere?

If, out of this modern jumble we can trace a direction which is worth while, then let us try to bring as much of contemporary life as we can into accordance with it. If we see a gleam, let us follow it. In our days the Holy Grail is searched after by little cliques; what the people in general search after we know not, unless the newspaper headlines are a correct indication.

We are inclined to the belief that the policy of *laissez faire* and the philosophy which says "things are bound to be all right in the long run" are amongst the most expensive luxuries that man can be called upon to pay for. It is perfectly evident that the disorderly, chaotic "Progress" that has gone on ever since railways were invented, has brought about the present war. Our hope and to some extent our belief, is that modern chaos in bringing forth war has died of the monstrous birth. Putting the matter without undue optimism, we can say that if the war does not show us the right road to travel on it will at least show that the old road led to regions we have no desire to revisit.

Phenology

THE recent publication by the Weather Bureau of two important contributions to phenology, already mentioned in these columns, calls attention to an interesting border science between meteorology and biology, information concerning which is not especially easy of access. The last edition of the "Encyclopaedia Britannica" contains no article on this subject, nor does the word "phenology" even appear in the general index to that work, yet there is a large corps of phenological observers in Great Britain, and the Royal Meteorological Society, of London, has published a manual of instructions for taking phenological observations.

Phenology is the study of the periodic phenomena of plant and animal life in their relation to weather and climate. Plant phenology has been studied from two points of view. Many phenologists are content to gather statistics concerning the dates of leafing, flowering, and other phases of plant life for different localities and successive years, and to make these statistics available in the form of tables and charts. The compilation of such data calls for a corps of careful observers, who shall note the periodic phenomena of a specified list of plants from year to year. The results of their labors possess an interest dependent upon the fact that a plant is a complex instrument, which records the combined and accumulated effects of atmospheric conditions.

The utility of phenological observations can perhaps best be illustrated by reference to a German example. In the Grand Duchy of Hesse the observations for a number of years, at various stations, have been compiled by Dr. E. Ihne, who has published a chart showing the progress of spring weather over the country in an average season. The beginning of spring is assumed to coincide with the average blossoming date of a number of native plants, and also, approximately, with the blossoming of the earlier varieties of apple. Dr. Ihne's chart shows the date of the "phenological spring" in all parts of the grand duchy, ranging from April 21st to May 20th, the latter date being recorded in the mountains only. A chart of this character is more useful to the agriculturist and the horticulturist than any compiled from meteorological observations, for it shows where the season is "early" or "late," directly in terms of plant life. It is thus possible to select early or late varieties of crops or fruits, according to the natural requirements of each locality.

Several other phenological charts have been published for European areas, but none for any part of this country. In fact, there has been no systematic collection of phenological observations in the United States on a large scale, suitable to form the basis of such charts, with the exception of the work done years ago by Prof. F. B. Hough, who organized a system of observation in New York State, and afterwards compiled observations from many other states for the Smithsonian Institution.

Aeronautics

American Automobile Manufacturer Enters Aeronautical Engine Field—It is announced that one of the leading manufacturers of automobiles in this country is about to engage in the manufacture of aeronautical engines. Already the concern has acquired a large tract of land on Lake St. Clair, near Mt Clemens, Mich., for an aviation field Aeroplanes will be received there within a short time and experiments will be made with regard to the engine requirements of aviation, at an early date. For the present, at least, the company only contemplates making aviation motors and not the complete aeroplanes

Inferiority of American Aeroplanes.—Surely the words of Lieut. J E. C Scott, a British aviator and aeronautical engineer, who is in this country on a diplomatic mission for his government, are not complimentary to domestic manufacturers of airships when he states that not a single aeroplane made in the United States is capable of the service demanded at the front He adds that not a single motor made in this country is capable of rendering the service needed by Allied aviators He attributes the shortcomings of American aircraft to two causes first our constructors are careless and do not take the pains in building their machines that the French and British makers do, secondly, they have not yet learned the requirements of military service.

Low-Flying German Aeroplane—In contradistinction to the greater part of the aircraft engaged in the present war which, in order to secure immunity from anti aircraft guns, fly at high altitudes, it is learned that the Germans have devised and introduced into service an aeroplane that flies below the line of fire of these guns It is exceeding fast and flies so low that anti aircraft artillery cannot be trained on it so that the shells will burst with accuracy However in securing immunity from these guns it comes within range of rifle fire and machine gun fire, and as a protection against these it is heavily armored Flying close to the ground, the occupants of the new German aircraft are in a position to locate accurately the position of troops and masked batteries, and secure much military information of inestimable value

German Biplane of Double Fuselage Type—An account of the capture of a large German aeroplane appears in a recent issue of the *Russkoie Gloro*, which states in part "Some time ago on the northern front our artillery succeeded in bringing down a German biplane with two unusually large fuselages and two tails. Each of the armored fuselages contains two machine guns and a light, quick firing gun, besides ammunition receptacles. Propulsion is by twin engines, each developing 170 horse power In the center, midway between the fuselages, but a little lower, is the pilot's nacelle, protected by armor The crew of the machine consists of six men, including pilot observer and mechanic." Evidently, this machine is a modification on an ascending scale of the well known "Fritz" type of biplane, which has made its appearance over the western front from time to time

New Fokker Monoplanes—The German monoplane of the Fokker type, of which so much has been said of late, is not strictly a novelty, in fact, it may be said to be designed largely along the lines of fast French monoplanes which have proved most effective in the hands of highly skilled pilots. The special feature of the Fokker monoplane is that its construction is based on steel tubes covered, as a protection against rust, by something of the nature of waxed canvas. The tubes are rectangular in section, and are closed at the rear in knife edges. The engine is armored and usually of 150 horse-power It is said that the Fokker machines have a speed of 110 miles an hour and can reach a height of 7,500 feet in 10 minutes. They are usually designed to carry one person, who is armed with a machine gun which shoots through the propeller in front. In some instances the Fokkers are fitted with two machine guns, each having a belt of 250 cartridges.

Zeppelins Built Since the War.—According to a recent press dispatch from Berne, Switzerland, there are now some eighty Zeppelins in the German service This statement is said to be based on information developed at Friedrichshafen, where the airship works are located. Recently, one of the latest type Zeppelins made a trial flight. It bore the number LZ-95, and in design varied considerably from the ante bellum Zeppelins. Its gondolas are said to be of plated steel The craft is plentifully supplied with machine guns and apparatus for throwing bombs and aerial torpedoes, among the latter being a new type which is reported to be far more powerful than any heretofore developed. In fact, rumor has it that the new aerial torpedo is to play a prominent part in the event of the German warships and Zeppelins coming out from their sheltering harbors and engaging in battle with the British fleet in the North Sea.

Astronomy

Photoelectric Measures of Variable Stars.—Several interesting contributions to the study of variable stars effected with the photoelectric photometer are announced in *Astronomische Nachrichten* by Messrs Guthnick and Prager Numerous measurements of Alpha Cygni have confirmed the suspected variability of that star the amplitude being 0 07 mag Evidence of variability has also been found in Alpha and Gamma Lyræ, the average amplitudes being 0 04 and 0 03 mag, respectively

Manuscripts of Copernicus.—Until recently the number of known books containing manuscript notes by Copernicus was fifteen This number has now been increased through the researches of a committee of the Academy of Sciences of Cracow which has been at work in the archives and libraries of Sweden since 1911 and has found, among other treasures, no less than 30 books containing notes in the handwriting of Copernicus Details on this subject have not yet been published

The Smithsonian Observatory on Mt Wilson—The last report of the Smithsonian Astrophysical Observatory notes considerable progress in the work of the observing station maintained by this observatory on Mt Wilson Cal (which is also the site of the great Carnegie Solar Observatory), where a 40-foot tower is being equipped with a tower telescope for use when observing, with the spectrobolometer the distribution of radiation over the sun's disk The observatory secured a Congressional appropriation of $2 000 for this apparatus. Tower telescope observations are now made at seven different wave-lengths of the spectrum on each day that solar-constant measurements are secured

Latitude Variation Work at the Naval Observatory—The latitude variation work which has been carried on for some years at Gaithersburg Md, under the auspices of the International Geodetic Association, was discontinued last year, and the photographic zenith tube lately used at that station has been lent to the Naval Observatory, in Washington which will take over the work A building of sheet iron louver construction, with removable roof, is being erected at the Naval Observatory to house the apparatus. As we have previously reported, the work of the International Geodetic Association is one of the few international scientific undertakings that have not been interrupted by the European war

New Astronomical Observatories.—Plans are on foot to erect an astronomical observatory on Volkollen, one of the highest mountain summits in Scandinavia A citizen of Duluth, Minn Mr J H. Darling, has undertaken to erect an observatory on one of the public playgrounds in that city and to equip it with a 9-inch equatorial refractor Plans have been drawn for an observatory in Toronto to serve as headquarters of the Royal Astronomical Society of Canada The building is to be erected in a public park, and maintained by the University of Toronto The proposed equipment includes a 20-inch telescope This project is at present in abeyance on account of the war

Spectrum of the Companion of Sirius.—The idea of photographing the spectrum of the companion of Sirius is startling in its audacity, even in an age when so many other miracles have been achieved Every student of astronomy recalls the romantic history of this star the existence of which was predicted by Bessel in 1844, on account of the irregular proper motion of Sirius, eighteen years before it was actually seen for the first time by Alvan Clark, Jr It has always been a difficult telescopic object, in consequence of the overpowering brilliancy of the primary Several attempts have been made at the Mt Wilson Observatory during the past two years to photograph the companion's spectrum "The great mass of the star,' says Walter S Adams, "equal to that of the sun and about one half that of Sirius, and its low luminosity, about one-hundredth part of that of the sun and one ten thousandth part of that of Sirius, make the character of its spectrum a matter of exceptional interest. The spectrum photographs have been mostly taken at the 80-foot focus of the 60-inch reflector, with the Cassegrain combination of mirrors. Although Sirius is kept behind a black metal screen, the field containing the companion is strongly illuminated by the light of the primary The earlier photographs showed a decided maximum in the spectrum at the point where the companion was kept during the exposure, but without a distinct line of separation from the general spectrum due to Sirius. Finally, last October, a photograph was secured in which a separate narrow spectrum was found corresponding to the point on the slit at which the companion was held, and this can hardly be other than the spectrum of the companion. The line spectrum of this body is apparently identical with that of the primary, but its continuous spectrum appears to fade off more rapidly in the violet. Several astronomers have suggested that the companion shines, at least in part, with light reflected from Sirius.

Radio Communication

Ordering a Dinner by Radio Telegraphy—Perhaps the most novel application of wireless telegraphy today is that for ordering a dinner A New York restaurant has recently announced that passengers on steamers bound for that port can make arrangements by wireless to have a table set before they arrive. To facilitate ordering by wireless there has been compiled a list of abbreviations Thus the tourist is now assured of a tempting meal ready to be served the moment he reaches the restaurant in question

The Tufts Radio Station near Boston Mass, has recently been completed and experiments are now being conducted with it The new steel tower, which replaces that blown down last Fall by a gale, is over 300 feet high being the largest in New England and the third largest in the United States The tower is supported on four special insulators imbedded in 15 tons of reinforced concrete The station is primarily intended as a laboratory for research work by a local wireless company

Increasing Employment of Arc Generators—The English *Electrician* in a recent editorial, comments on the action of the United States naval authorities in asking for quotations for a 300 kw arc generator, as follows "The British & Overseas Engineering Synd (Ltd) write saying that for the past two years arcs of 100 kw and 200 kw have been installed and are operating across the North Atlantic, and there is no difficulty at all in the construction of arcs of much larger sizes During the last two years considerable experience has been gained in connection with these large arcs, and a good many new patents have been taken out in connection with them"

New Organization for Wireless Amateurs—Several weeks ago the articles of incorporation for the National Amateur Wireless Association were signed by Supreme Court Justice Ford It is said that the purpose of the new association is to prepare for war by forming amateur wireless telegraphists into a military signal corps. One of the aims of the new organization is to direct experimental work on the part of amateurs and to maintain a central bureau of information. When it is recalled that the war in Europe has necessitated the enlistment of an unprecedented number of wireless operators, the value of the work to be done by the new organization is at once apparent.

Wireless for Mississippi River Barges—A navigation company is building at the present time 36 power barges varying in tonnage from 1,800 to 5,000, which are to be equipped with wireless apparatus. These barges are intended for service on the Mississippi River between Minneapolis and New Orleans, with stops at all important points on the Mississippi River and its tributaries. Each of the barges will be equipped with a 2-kw 500-cycle panel type quenched gap set, which is believed to be ample for a continuous range of over 400 miles. Radio communication will thus be insured between barges and shore stations, and this service is expected to be of particular value in keeping shippers advised of market conditions and directing the trans-shipment of cargoes to take advantage of favorable developments The barges are to be equipped with four 80-horse-power engines working separate propellers There will be an express and a slower service the former being built for a speed of 18 miles per hour upstream, and 24 miles an hour downstream, while the slower barges will make 8 miles an hour upstream and 12 miles an hour downstream

Mobilization by Wireless—According to reports, on Washington's Birthday, February 22nd the United States Government plans to carry out an interesting and important test in conjunction with the tens of thousands of wireless amateurs throughout the country It is learned that the present plans call for the sending out of a test war message from the radio station at Rock Island Arsenal, Ill At 11 o'clock on the night of February 21st, Central time there will be sent out broadcast a "stand by" signal and all amateurs are expected to receive and comply with this request. There will then be delivered by messenger a military dispatch to the Rock Island Arsenal, from the Federal Government. The message will then be seen for the first time by the wireless operator who will thereupon flash it out to all stations within hearing distance It is understood that one of forty five designated stations will receive the message and then relay it to the next group of stations whose operators will also relay it to the following group, and so on It is said that the message is to be delivered in each city or state to the Mayor or Governor, and that the purpose of the experiment is to determine how quickly an army of 3 000 000 soldiers can be mobilized Whatever may be the actual purpose of the experiment, it is safe to predict that the efficiency and value of the amateur wireless stations and their personnel will be again proved to the Federal authorities.

Carnotite ore ready for shipment at coke ovens

Industrial Preparedness Series

Extracting Radium from American Ores

By Herbert T Wade

A vein of carnotite ore, at Bull Canyon, Colo.

THAT the United States is now independent of Europe for its supply of radium has been demonstrated by the successful operation of a large experimental plant at Denver, Colo under the joint auspices of the National Radium Institute and the United States Bureau of Mines It is now possible to utilize in a commercial way the carnotite ores of Colorado and Utah, and obtain this valuable element which has already become so important in medicine and surgery Indeed aside from the war cutting off European radium some of which was extracted from American ores the supply available for American hospitals is far from adequate and it was largely this consideration that led to the formation of the National Radium Institute by Dr Howard A Kelly of Baltimore and Dr James Douglas the well known mining engineer of New York city Accordingly when the National Radium Institute proposed to place at the disposal of the United States Government certain claims in the Paradox Valley, Colorado leased from the Crucible Steel Company, containing carnotite a rare metal bearing ore containing uranium oxide in large quantities, and capital up to $150 000 for constructing and equipping a plant that would turn out radium on a large scale the Bureau of Mines gladly agreed to coöperate The research and technical work was to be in the hands of the Government scientists under the general direction of Dr Charles I Parsons, Chief of the Division of Mineral Technology, and Dr R B Moore Physical Chemist of the Bureau, was placed in charge of the laboratory and refining plant which was built at Denver The mining and concentration of the carnotite ore was carried on under the direction of an assistant mining engineer and experimental work analyses and measurement undertaken by a well-organized technical staff A suitable plant was erected and equipped, and began to supply radium regularly in June 1914 and in February 1915 its capacity was increased by additional buildings and equipment more than 100 per cent The plant as now in operation includes its main buildings and laboratories a grinding and sampling mill and a nitric acid plant

The work of this most interesting installation has recently been described in Bulletin No 104 of the United States Bureau of Mines, which is a substantial contribution to the technical literature of radium Not only were former methods of extracting radium from the ores studied by the experts of the Bureau, but new methods were discovered, and it was shown that by using a new and special process the cost of producing radium need not exceed $40 000 per gram, and that 90 per cent of the radium contained in such ore as was available to the Bureau could be extracted When it is recalled that radium has been selling in the United States for about $120 000 per gram the importance of the work may be realized

In the preparation of radium on a commercial scale one of three general classes of methods usually is followed (1) Use of acid leach (2) Use of an alkaline leach followed by an acid leach, (3) Fusing the ore with some material that will break up the ore and make the extraction of the valuable contents possible These methods, however, the United States Government investigators after investigation, set aside in favor of a new method which made use of nitric acid in which incidentally sodium nitrate was recovered as a by product and from which nitric acid could be once again made This process gives the radium at once in the form of a high grade radium barium sulphate, which is practically free from silica and easily treated further In addition to the radium the uranium and vanadium contained in the carnotite can also be obtained The general process of extraction is indicated by the accompanying diagram

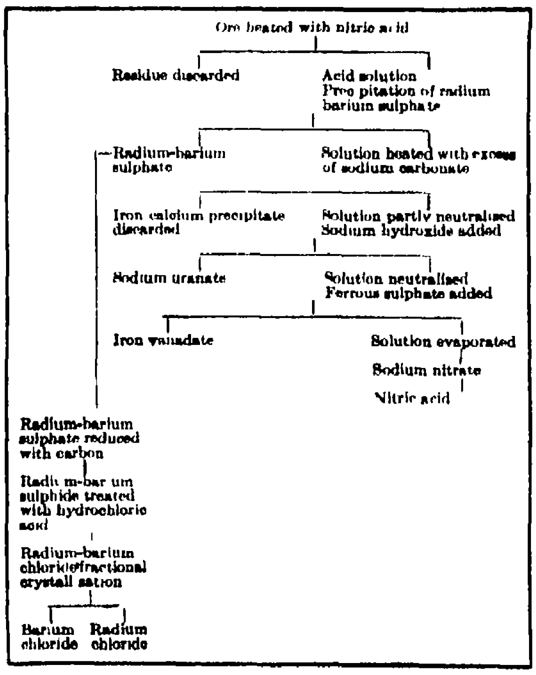


Diagram of Steps of Bureau of Mines Method of Radium Extraction

The ore is first ground to 20 mesh, then leached with strong hot nitric acid After the acid is drawn off into an earthenware vacuum filter the remaining sand held back in the pot is given an acid wash with weaker acid and then after being dumped on the filter is washed with hot distilled water, the entire process consuming about seven hours. The filtrate is diluted with water and sodium hydroxide is added so that radium barium sulphate is precipitated This is further treated, and finally the radium barium sulphates are placed in iron pans and dried in a hot air oven These radium barium sulphates then are refined and the first process is to obtain a high grade sulphate, eliminating the silica and other impurities The original sulphates are then reduced with carbon either in an electric or oil furnace and then the sulphide is treated with hydrochloric acid, so that it becomes radium barium chloride from which by a process of fractional crystallization the barium chloride is crystallized out, the main difficulty being with lead, which, unlike the other metal salts, requires special treatment The barium chloride and radium chloride are then treated with ammonium carbonate, and carbonates are obtained which are dissolved in hydrobromic acid and are evaporated to give bromide crystals. After the final fraction the crystals are collected in glass tubes, which are sealed and measurements are taken from time to time Finally by a process of higher fractionation the radium is separated and is obtained in the form of radium bromide

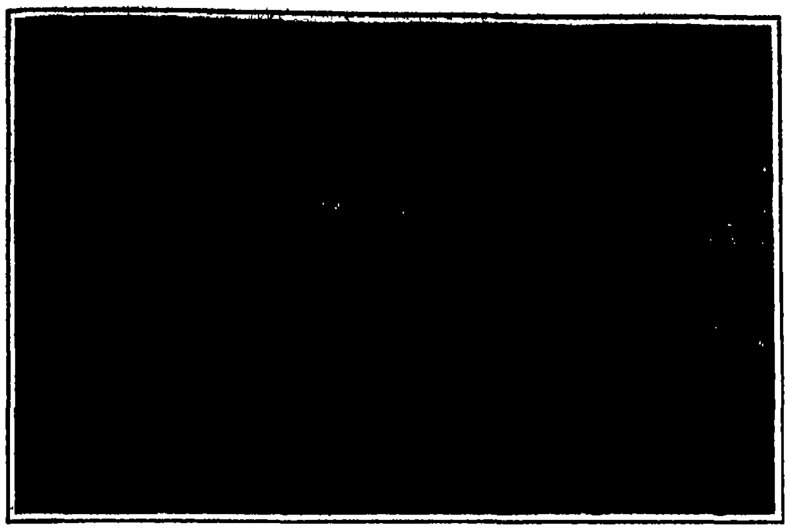
The Denver laboratory of the U S. Bureau of Mines, showing Prof R. B. Moore in charge of the office and Karl Kithil, special investigator

The filter presses in the new plant

Of course this method which is merely outlined requires infinite care and patience, and must be accomplished by frequent measurements with a special electroscope to determine the amount of radium present.

The delicacy of modern chemical method is shown in the fact that there is extracted from the ore an element that exists in it in the proportion of 1 part to 200,000 000, so that in working a process on a wholesale scale, not merely in a laboratory, there are involved refinements which are not ordinarily encountered in metallurgical operations. Accordingly when it is realized that 90 per cent and over of the radium present has been reclaimed by the nitric acid method, where anything over 50 per cent would have been considered satisfactory, the success of the work of the National Radium Institute can be realized Up to September 1, 1915, 1,947 5 milligrams of radium in the form of high grade chloride or bromide had been delivered out of 4,774 milligrams of radium produced as sulphate This varied in purity, running all the way from 6 to 15 per cent to high grade product of as much as 87 8 per cent. The cost of producing the radium is also considered in some detail. The average cost of 1 gram of radium based on the production up to August 1, 1915, or from 4,258 milligrams of radium element costing $155,322 09 was $37 599. In addition there were extracted 81,690 pounds of uranium oxide and 11,528 pounds of vanadium oxide. The average cost of the ore was $96.36 a ton, somewhat below the ordinary commercial value, so that had the ore cost $120 per ton, a fair value, it would have brought the cost of radium to $41,742 per gram, and an increase in cost of $20 per ton over this amount would have increased the cost approximately $4,000 per gram.

The results of this investigation are of great and varied interest. It is shown



Furnaces for the reduction of sulphates and refining of sodium uranate

Recovery of sodium nitrate, showing the evaporation and crystallizing pans

that radium can be produced commercially from American ores, as the patents are available to any citizen of the United States, that there are ore deposits that may be utilized for producing the radium in greater amounts than previously, and finally that radium for use in the Government hospitals and other experimental work can be obtained from Government lands, if such still exist, or from ore purchased in the open market.

The Use of X-Rays With Intervals of Red Illumination

By Jacques Boyer

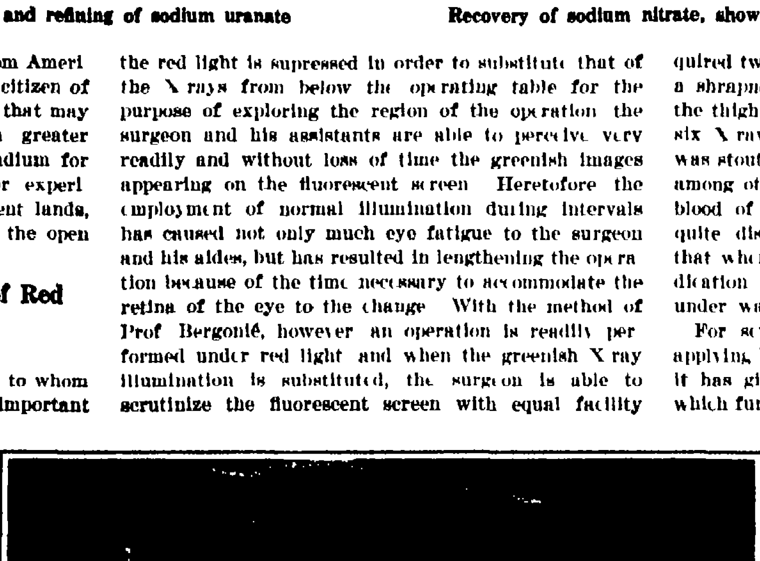
PROF J BERGONIÉ of Bordeaux, France, to whom electricity in medicine owes a number of important advances, has recently evolved an original method of applying X rays in surgery

At the present time the surgeon, manipulating his instruments under the fluorescent screen, is compelled to work in darkness, although all the while he exposes himself to the harmful effects of the X rays On the other hand, the surgeon working in bright light is obliged to depend on an assistant who, alone in a position to see the X ray images on the screen, guides him in his work Because of the drawbacks of both these methods many surgeons prefer to perform their work without the aid of the X rays The new method worked out by Bergonié, which is based on the law of simultaneous contrast of colors, will undoubtedly cause many surgeons to resort to the use of the X rays in their work The principle involved, originally formulated by Chevreul, is best demonstrated as follows

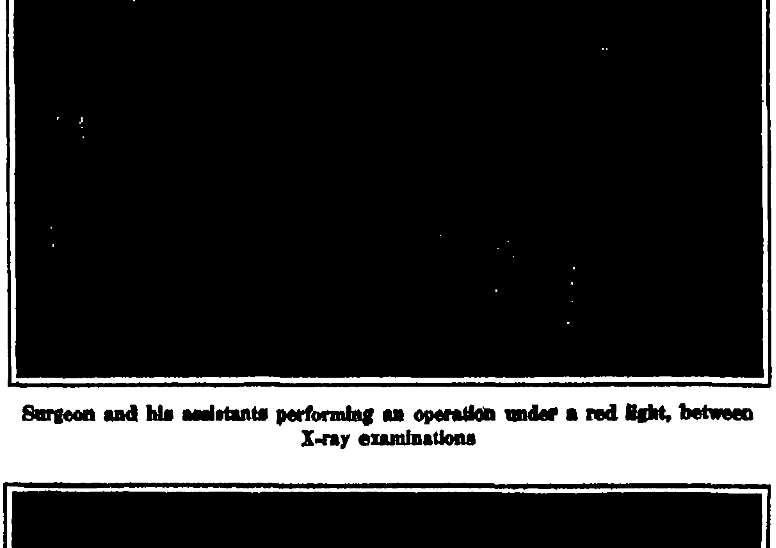
If the eyes rest for several moments on an object of a certain shade, after which they are turned away, the eyes retain for a few instants the complementary color of the subject previously observed, this phenomenon being due to the persistence of luminous impressions on the retina of the eye For example, observe for a few moments a red flower and then turn to a disk of white porcelain The disk will appear to be of a greenish tint As Chevreul has demonstrated, this phenomenon is one of the reasons for the intensification of a color impression when two complementary colors are placed in juxtaposition. Modifying the experiment just cited by taking a disk of greenish shade it will be observed that the green is intensified by the green impression made on the retina of the eye by the red vision. Likewise, if the eyes are brought to bear on the red flower, its color will be increased with the red impression given to the retina by the green disk In conclusion, the two colors reciprocally improve each other, and Prof. Bergonié has made use of these facts to facilitate the task of the surgeon who, in the course of an operation, utilises the X rays in order to see through the body of his patient.

After being placed in a darkened chamber, Prof Bergonié illuminates the operating room by means of an intense red light of great purity, in which there is not a single green or yellow radiation such as are emitted by the fluorescent screen of the X ray apparatus. Due to the effect of contrast, the sensibility of the retina of the surgeon and the assistants is conserved and even increased during the period of surgical intervention using the red light. Furthermore, when the red light is supressed in order to substitute that of the X rays from below the operating table for the purpose of exploring the region of the operation the surgeon and his assistants are able to perceive very readily and without loss of time the greenish images appearing on the fluorescent screen Heretofore the employment of normal illumination during intervals has caused not only much eye fatigue to the surgeon and his aides, but has resulted in lengthening the operation because of the time necessary to accommodate the retina of the eye to the change With the method of Prof Bergonié, however an operation is readily performed under red light and when the greenish X ray illumination is substituted, the surgeon is able to scrutinize the fluorescent screen with equal facility since the retina is immediately accommodated To state the Bergonié method definitely The active phases of an operation are executed under red light, while the X ray examinations of the patient's body in the region of the operation are made in the greenish light of the X-rays for an interval seldom exceeding 30 seconds. As to the number of examinations required, this is determined by the case at hand for instance, one case in which shrapnel was extracted from a man's heel required two radiograph examinations another in which a shrapnel splinter was dislodged from the region of the thigh bone at a depth of ten centimeters, required six X ray examinations—the patient in this instance was stout and muscular It is of interest to note that, among other peculiarities a pure red light causes the blood of the arteries to appear almost colorless and quite distinctive from the blood of the veins, and that when the blood becomes almost black it is an indication that the chloroforming of a patient is well under way

For several months past Prof Bergonié has been applying his method in the hospital of Bordeaux where it has given much satisfaction The luminous dome which furnishes the red light is placed directly over the operation table and is of about the same dimensions as the latter so as to avoid shadows being cast on the patient The dome contains 20 lamps of 25 candle power each, the rays of which pass through red glass Although the illumination thus furnished is admittedly poor, as may be noticed in one of the accompanying illustrations, the surgeons declare that it is sufficient for their purpose



Surgeon and his assistants performing an operation under a red light, between X-ray examinations



Examining the region of an operation by means of a fluorescent screen, which is excited by the X-rays

Effect of Static Charge Upon Rubber

FONTANA showed that the inside volume of a Leyden jar increased during an electric charge If the jar contains water which serves as one of the coatings the level of the liquid is seen to lower when the jar is charged on account of the jar's increase in volume Later on, Korteweg and Julius showed that in the case of rubber as dielectric the deformations vary roughly as the square of the dielectric field The French scientist, L Bouchet, now makes a series of careful researches as to the effect of the electric charge upon rubber, and uses a rubber sleeve which undergoes the action of the charge on both sides so as to produce an analogous effect to the Leyden jar experiment Water contained inside the sleeve communicates with a capillary tube so that any small change in volume is readily seen in the height of the liquid in the tube and the water level is observed by a microscope He used a high tension dynamo furnishing 550 1200, 1800 and 2520 volts, and the water level was noted at regular intervals during 2 minutes after the action of the electric charge, in each case During that period, the level first lowers quickly then more slowly and finally reaches a fixed point The author already noted that under the action of constant mechanical pressure of about the same order of strength as here used the same rubber piece required about 20 seconds to reach the limit of deformation This limit is now greater in time for the electric action and he concludes that up to the 20th second there is a combined electrical and mechanical effect, while after this point the electric effect proper is the only one which enters in

Game Sanctuaries in the National Forests

ACCORDING to the *Geographical Review* Dr W T Hornaday is urging upon Congress the passage of a bill authorizing the Secretary of Agriculture to take over those parts of the national forests that are not adapted for other purposes and establish in them game sanctuaries where game will be bred and set free.

Industrial Preparedness for Peace

III. Things Done and Undone

By Miner Chipman

JOHN A. KELLEY, Manager of the Industrial Bureau of the Chamber of Commerce of Columbus, O., is thoroughly alive to the problem of Industrial Preparedness for Peace. He offers some real suggestions in a letter to the writer under date of January 20th. This in particular: "South America offers a good field, but most manufacturers here are inclined to 'let it alone.' The Chamber of Commerce interested eight local manufacturers in banding together and hiring a salesman who is now in the Latin American countries, and making good. Several other companies have their own agencies in South America. In preparation for conditions after the war I believe that each manufacturing craft should finance its own commission to investigate conditions and suggest necessary steps for preparation. By each craft I mean the automobile, the machine product, the glass, iron, etc. Then the Federal Trade Commission and a Permanent Tariff Commission should coöperate and take cognizance of the suggestions of the various craft commissions wherever it is thought necessary to have the assistance of the Government. But each industry must look to its own salvation. The manufacturing business of this country is too great and complex to expect the Government to take care of each branch of it. Our manufacturers must make a science of their business. There are too many 'jumping in where angels fear to tread.' Their horizon is bounded by *the walls of their factories* and they do not know what the spirit of coöperation means. They need education and need it badly. Our Chamber of Commerce has suggested, and urged to successful conclusion the establishment of a College of Commercial and Business Administration, and we are *going to urge the State of Ohio to spend* some money on this college. We have paid too little attention to the education of the manufacturer in a broad way."

The President of the Grand Rapids Association of Commerce, Mr. Charles B. Kelsey, sounds a note of warning against anti-business legislation as follows:

The United States has an opportunity to add many great industries as a result of the great war now in progress. One of them is that of making our own dye stuffs. All that is necessary to the permanent establishment of this important brand of industry is a settled policy which shall protect those who are engaged or do hereafter engage in the business from foreign competition, which is sure to come after the war is over. A declaration of peace will at once stop the demand for war supplies and there will be a sharp decline in the prices of all materials and commodities that enter into this abnormal trade, and a slump in the stocks of those institutions which are largely engaged in this trade. No man can foresee just what effect peace will bring. It will no doubt stimulate trade and commerce in certain directions and injure it in others. The nations exhausted and prostrated as they will be by their great sacrifices of men, credit and property, will strive hard by every means to regain lost trade and prestige, and we may be well assured they will leave no stone unturned to capture our markets, the biggest and richest in the world. If we are farsighted and wise we should see that our markets are secured to our American industries. I can only indulge in a hope that Congress may do something constructive for American industry. Our experience for the last decade will not warrant more than a hope. During that time in this country there have been passed 60,000 laws, a large portion of them aimed at the destruction of business, perhaps not premeditated, but in practice that has been the result. Strangulation in some instances and a slow lingering death in others is the legacy of legislation. During these years business has been conducted under conditions of doubt and uncertainty. The watchword in Legislative Halls has been 'Vacillation.' It would be difficult in this vast maze of laws to find any that were constructive or pretended to be helpful to business."

Mr. Kelsey is a business man. He is pouring out his heart against destructive legislation. It is well for us to give an open ear to this wail from over-legislated business. Mr. Kelsey takes a whack at the "legal mind" and the lawyer legislator as he concludes his letter: "I think the greatest factor to a steady and healthy condition of business in the United States would be to retire from Congress most of the lawyers and replace them with *business men*—men of affairs, men of industry, those who have first hand knowledge of trade and commerce and look payrolls squarely in the face. We would then get some measure of efficiency in public business—something constructive for the people. We are the greatest industrial people on earth but few of our industrial leaders are in Washington."

The Johnstown, Pa., Chamber of Commerce has been endeavoring to acquaint the local industries with the foreign trade market through the department of Foreign Commerce of the National Government. The secretary thinks that the establishment of a non-partisan tariff commission by the Federal Government will do much to protect American industries from unfair competition after the war. Business has been on the boom in Johnstown, and notwithstanding the tremendous munition work carried on by the Cambria Steel Company employing 17,000 men, a great deal of *Johnstown's business prosperity has been in munitions* of peace rather than war materials.

The Chamber of Commerce of Charleston, S. C., has been busy in arousing local interest in matters of preparedness for industrial prosperity. A recent campaign for members netted 1,000 new names to their *roster. Various bureaus, under trained and well paid* officials, are taking up different problems confronting Charleston's preparedness problems. The Secretary of the Chamber of Commerce very naïvely says: "The curse of individualism is dead in Charleston and the business interests of this city are now thoroughly united, working *together* to protect mutual interests and for the general improvement and upbuilding of the entire community." It is essential that Charleston, as represented in its local Chamber of Commerce, now remove that spirit of individualism within itself, and work for a united and universal preparedness for peace of a nation-wide significance. Although it is not suggested that "Our Town" is the slogan for preparedness for peace, we must be sure that we realize that this problem is national and not local.

John Franklin Crowell, writing in behalf of the Chamber of Commerce of the State of New York, advises me that their organization has at the present time a large committee on Problems of Shipment during the European war, of which President Seth Low is Chairman. This is a strong committee and has given most of its attention to the subject of providing a merchant marine. Industrial Preparedness for Peace is being closely followed up by this organization.

The Executive Committee of the Philadelphia Chamber of Commerce has employed Mr. F. W. Lawrence of New York, as head of the Industrial Bureau. In outlining the functions to be performed by Mr. Lawrence, the Philadelphia Chamber of Commerce has made a splendid contribution to Industrial Preparedness for Peace. The work of the Bureau will begin with an industrial survey, advantages of which may be stated as follows:

(From the Journal of the Philadelphia Chamber of Commerce.)

1. Will furnish an accurate descriptive inventory of the industrial advantages and disadvantages of Philadelphia.

2. Will enable the Industrial Bureau to conduct its work more intelligently and efficiently to get the facts needed to place proper information before prospective manufacturers, and to serve as a basis for (a) remedying defects which are handicapping the city industrially, and (b) conducting a general campaign for new industries.

3. Will give information as to the percentage of manufactured goods consumed locally, furnishing a basis for developing plans for increasing the local demand for Philadelphia products.

4. Will indicate to bankers which industries already located here are capable of extraordinary expansion, if adequate financial assistance is given.

5. Will reveal the types of industry not already represented here, but which should naturally thrive in Philadelphia.

6. Will furnish comprehensive knowledge as to labor conditions in Philadelphia, including the relation of the industries requiring male and female help. Frequently industries requiring female labor suffer from lack of industries requiring labor of males with families.

7. Will enable the people of the city of Philadelphia to grasp comprehensively the industrial status of Philadelphia and to encourage every citizen to disseminate information upon the widespread industrial activities of Philadelphia, thus developing a greater civic patriotism.

8. Will show the source of supply of material entering into the finished products and indicate the opportunities for starting new industries in Philadelphia in which there is a local established market.

It is planned to bring under the supervision of the Chamber of Commerce, business executives of the city, also the department managers of the different concerns with a view of exchanging ideas and benefit from each other's knowledge *and experience*. The Secretary of the Industrial Bureau of the Chamber of Commerce of Philadelphia has gathered much information, showing how executives of other cities have in this way increased production, reduced production costs and at the same time raised the standard of living of the *labor engaged in industry*.

The Detroit Board of Commerce is a live-wire organization utilizing every opportunity to make adequate preparation for conditions following the European war. They have organized a large Salesmanship Club under the guidance of such men as Mr. Hugh Chalmers and Norval A. Hawkins and others. *They are planning for* a World's Salesmanship Congress to be held in Detroit in July. The Board of Commerce has also organized a School in Scientific Management in which the executives and engineers of Detroit's large and prosperous industries are taking an active part.

The Louisville, Ky., Board of Trade has issued a Report on the Need of a Merchant Marine. This report was prepared by a special committee appointed by the Board, and was mailed to all kindred commercial organizations, and to congressmen and senators. This report brings forth some very significant facts, and it will not be amiss to make the following quotations:

"The following comparison in dollars and cents per hundred pounds on tobacco in hogsheads, as of December 20th, for three representative years, is illustrative of the abnormal tax on our commerce to European ports:

From New Orleans	1915	1913	1910
To Liverpool	$2.28	$0.53	$0.85
To Rotterdam	2.75	48	.34
To Havre	2.15	48	.38
To Genoa	2.10	50	.31

"It has not been uncommon of late for the price of a ship to be made on one cargo and it is of record where a cargo of coal from the Atlantic seaboard to Sweden paid an ocean rate of $14.00 per ton.

"It is, of course, recognized that recent conditions and present ocean rates are abnormal, due to the European war, which has served to withdraw from foreign trade all of Germany's merchant vessels and to so greatly reduce England's ocean carriage of commercial tonnage. It has also had the further effect of advancing to almost prohibitive figures ocean rates of neutral vessels.

"Notwithstanding these unusual conditions, it is now well recognized that even under normal conditions the number of merchant vessels available for shipping from United States ports and particularly vessels owned by citizens of the United States, is inadequate to insure any expansion in foreign trade on the part of this country. It is also further recognized that if there is to be any substantial expansion in the foreign trade of the United States, after the close of the war, it must be through the means and by the assistance of an American Merchant Marine.

"The attention of Congress, and to some extent, the country at large is apparently centered on preparedness for war. Without offering any objection to, or adverse criticism of, reasonable preparedness against war, we express the belief that preparedness for peace should, at the same time, be the first and paramount consideration on the principle that in the present depleted financial and physical condition of the great European nations, a war with any of those countries is remote, whereas commercial preparedness is pressing and insistent at the present moment."

I am sorry to say that from a large number of officials of chambers of commerce throughout the country I have received letters indicating an indifference upon the part of the members. From a large eastern city, the Secretary of the Chamber of Commerce writes: "During the last seven months efforts have been made along every line which came to our attention to assist the business men and manufacturers as suggested by you, but we absolutely found nothing but indifference to our thoughts or action." Another aspiring city within

(Concluded on page 208)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Leprosy

To the Editor of the SCIENTIFIC AMERICAN

I am glad to see that your editorial in the issue of September 4th, 1915, has given rise to some discussion of the leprosy problem, even though that discussion seems somewhat hazy, and from a medical viewpoint—may I say it?—absurd. The statements and the questions propounded by your correspondent "Uno" in your last issue are typical of the confusion in the public mind on this subject, and would seem to have called for a less evasive and a more carefully thought-out reply than that given by Mr Wooley Although I am not professing to be an expert in leprology, I have studied the disease in this country, in Kalihi, Kalawao, and Kalaupapa in Hawaii, and in the interior of China and I feel strongly that certain popular misconceptions, shared apparently by both your correspondent and your editorial writer should be corrected

First in regard to the 'contagiousness' of the disease Mr Wooley asserts that "there is a distinction between infectious diseases and contagious diseases," but he does not define the distinction I will run the risk of repetition in order to make very clear these fundamental terms of the discussion since a large part of the misunderstanding as to the contagiousness of leprosy even among acknowledged experts, lies in the misconception of these common terms The word *infectious* has to do solely with the immediate cause of a disease, and has nothing whatever to do with the manner of its transference from one individual to another The term *contagious* has to do solely with such transference, and predicates nothing as to the cause Thus malaria is an infectious disease, because it is caused by an infection—*i e*, the successful invasion of the individual by a harmful micro-organism, but malaria is not contagious because it is not transmitted directly from one individual to another by contact or propinquity On the other hand, hysteria is often contagious in that it may spread directly from person to person as in many well known hysterical epidemics but it is not infectious, because it is not caused by the invasion by a harmful micro-organism

Now since the immediate cause of leprosy was discovered in the bacillus lepræ, there has never been any serious doubt as to its *infectiousness* As to the possibilities of *contagion*, however, there have always been and there are to-day, widely divergent views Without going into the minutiæ of the question the following facts stand out as incontrovertible first, that those who have been in prolonged intimate or careless contact with lepers often acquire the disease, and, secondly, that without such prolonged intimate or careless contact, it is extremely hard to acquire it.

It is astounding to meet with such a complete lapse of logic as is embodied in Mr Wooley's rash generalization that leprosy is not contagious, a statement which he bases four-square upon the *one* fact that he and a companion at one time spent many hours in a leper hospital in the Philippines, conversing with scores of lepers and photographing their sores and abrasions' Would Mr Wooley declare tuberculosis to be non-contagious because he had escaped taking the disease after an equal exposure?

Now as to the matter of the cure of the lepers. Here again Mr Wooley has made an optimistic generalization far overbalancing its very narrow foundations in fact. On the other hand, your correspondent's off hand statement that without any treatment whatever the anesthetic type of leprosy "generally dies out after 15 or 20 years" is not supported by the statistics of American workers at least. It is true that this type sometimes exhibits remissions, and that the victim may often die from some other intercurrent illness, but these cases are exceptions. Of all the thousand methods of treatment, not one has justified itself as "a cure for leprosy"

To my mind, the nearest approach to this is the treatment worked out by Dr Wayson, and mentioned casually by Mr Wooley This consists of an extremely ingenious method of auto-vaccination with the patient's own bacilli autolysed in the serum in a subcutaneous blister made by the application of solidified carbon dioxid to the skin overlying one of the leprous nodules. I have seen several cases completely cured by this method, and have photographed them (also without taking the disease!), but only a very small percentage of cases are cured by this or any other means. Chaulmoogra oil does exert a mildly beneficent action in the great majority of cases in some unexplained way, and it is the one standard remedy used in all, or nearly all leprosaria as a routine, but it cannot be called a cure.

There is a very great need for public enlightenment on the subject of leprosy, for the minds of most men are still under the thrall of the ancient biblical terror, and "Unclean! Unclean!" is still the first thought in the layman's mind. The danger from the presence of uncontrolled lepers in the community, the needless fear, and its resulting inhumanity can all be eliminated only by a campaign of education. The mastery of the disease itself can be entrusted to the steadfast and clear thinking men whose lives are devoted to this end

LOWELL C FROST M D

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The Submarine Question

To the Editor of the SCIENTIFIC AMERICAN

In your issue of January 22d, Mr F A de Peyster, of New York, takes exception to a statement of mine that submarines 'are worthless practically for defence," etc The question of value is one of effect upon strategy

In regard to the Dardanelles operations The submarines which were operating there were of the sea *going type* What they accomplished in the destruction of two enemy battleships was spectacular, but unimportant Now for what they did not accomplish They did not prevent the continued bombardments from the sea, the supplying and reinforcing of the enemy army or its successful withdrawal from Gallipoli The failure of the Allied operations at the Dardanelles was in no way due to the submarine Rather it was due to the early naval attack unsupported by a military expedition and the consequent loss of the chance for a surprise attack

Why have not the English dreadnaughts entered the Baltic? They are needed in the North Sea with the Grand Fleet. In forcing the entrance to the Baltic, the British sea planes would be used for locating the defending submarines and then their destroyers would go submarine hunting Submarines have been located by aircraft at considerable depths Granted that a few blows might be got home by the submarine defence but they would probably not be sufficient to change the preponderance of battleships which decides sea control It is hardly to be expected, however, that any serious attempt will be made to force the Baltic A look at the map will show the Kiel Canal To-day the British fleet by its battleship strength holds the German fleet to harbor, or the Baltic It is not injuring the Allies' cause, and control of the Baltic is not vital to their success Now supposing that England got foolish and despatched her fleet, or one half of it, to the Baltic What would be the probable outcome? Germany would have a fighting chance, to say the least, against a divided enemy, and would probably accept battle either in the Baltic or the North Sea. Probably the North Sea, as the Baltic is no more vital to her success than to that of the Allies The choice would fall to Germany, thanks to the Kiel Canal If the whole British fleet were despatched to the Baltic, there would be no battle only an invasion of England

While it is true that British submarines have entered the Baltic and the Sea of Marmora, and done considerable damage, of what effect has it been on the outcome of the war? About as much as the raids of the Confederate privateers against the commerce of the North in the Civil War The submarines which have accomplished these stunts are of the sea going type

Mr de Peyster says I believe no dreadnaught of the present design can operate near a hostile port if that port has submarines" For months battleships have been operating at the Dardanelles Then sea control does not depend upon the capital ships operating near hostile ports The dreadnaught is built for high sea operations which decide sea-control Picket boats, destroyers and light cruisers are sufficient for watching hostile ports.

The submarine question should be considered as to its probable relation to general engagements The modern fleet submarine, so called, is able when in the afloat condition to keep up with the fleet at medium battle speed—20 knots In this condition they are vulnerable to almost the lightest gun on the enemy's fleet. When submerged they would be unable to keep up with a fleet steaming at speed in action While a submarine screen might be thrown out and efforts made to draw the enemy fleet across it they would probably fail The submarines would be located by the air scouts and the admiral would fight shy of them If the enemy fleet withdrew too far or was beaten, the submarines would fall prey to the destroyers

As a commerce raider the submarine has made good This is its present sphere, and for a time at least its principal one

While the successes of the submarine have been spectacular, the things which they have failed to accomplish should not be overlooked. They have not seriously interfered,

First, with the commerce of the Allies.

Second, with the transport of millions of Allied troops over seas.

Third, with the Allies' control of the seas

Considering these three questions it is evident that they have failed to seriously effect the outcome of the war The construction of 85 coast defence submarines can not be too strongly condemned One of the big lessons of the Great War is the discrediting of the 'coast defence' type of ship Naval coast defence begins, and ends, upon the high seas, with the battle fleet

ROGER L. CORDON

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Labor and the National Guard

To the Editor of the SCIENTIFIC AMERICAN

I have read with interest the controversy between 'patriot" and 'citizen over the question of exempting the National Guard from strike duty That a patriot and a citizen should differ on this question is easily understood by everyone who understands both sides of the question

There is a correlative aspect, however, which it seems to me makes such exemption expedient whether approved on moral grounds or not To understand this aspect it is not necessary to consider the validity of the objection which labor sympathizers have to the use of the National Guard for strike duty It is only necessary to recognize that such *objection is very wide* spread and that it is based upon reasons which appear to labor so valid and important that labor sympathizers will oppose with all the force in their command, any system of preparedness which does not give assurance that the *preparations will not be used in industrial* disputes

It has been suggested that the reason why American men do not enter the National Guard is because they object to even the small modicum of discipline that is there required This is doubtless a reason deterring many, but the industrial reason would appear to be still more potent, because it is so widespread, and because it is founded upon strong and fundamental convictions

So *important does labor consider this question that* many thoughtful labor leaders suspect that the desire to have a strong national guard is influenced by the desire of industrial leaders to have a strong military force ready at hand to suppress inconvenient strikes.

The *question of adequately preparing this country* against invasion is one of such vital moment that the entire country should be united upon it For this reason every collateral question which is causing serious opposition to the main subject should be separated *from the main subject in order that the latter may be* settled separately

It may or may not be desirable to have an armed force for the maintenance of order in time of strikes The conflict on the subject is irreconcilable because it is *not a matter of mere difference of opinion*, but a fundamental difference as to the objects of government Because the conflict is irreconcilable it is futile to discuss it unless we care to plough deep into the subsoil of society It is moreover unnecessary in a discussion of *preparedness If such a force is needed we can* provide it whenever we can get sufficient unanimity of opinion to come to a conclusion It does not need to be the same force as that provided for protection against a foreign foe It is a needless befuddling of *the issue to discuss this question as thought it were* part of the subject of preparedness When such a force is needed let us provide a special force for it, and let there be no question in the discussion as to what the force is to be used for This is all irrelevant to *preparedness*

In the meantime it is believed that a large well organized national guard could be built up as a protection against invasion Without such opposition from the labor sympathizers if a clause be inserted in the enlistment papers, providing that the recruit can refuse to act, and terminte the enlistment whenever he is ordered to serve in an industrial dispute It would appear that such a clause could be so worded that the serviceability of the troops for national defense against a foreign *foe would not be impaired At the same time the in*sertion of such a clause in the enlistment papers would take away all foundation for the contention of labor sympathizers as to the real motives behind the demand for a larger national guard

A measure introduced proposing to create a national guard with such a proviso in the term of enlistment would probably receive no organized opposition from labor and yet would furnish the national protection which we seem to be needing The presentation of such a measure before Congress would neither be a disapproval nor an approval of the use of an armed force in industrial disputes It would be merely a recognition of the fact that such a problem is distinct from preparedness and one which should be separately considered so that the question of preparedness need not be imperiled

WILLIS B RICE

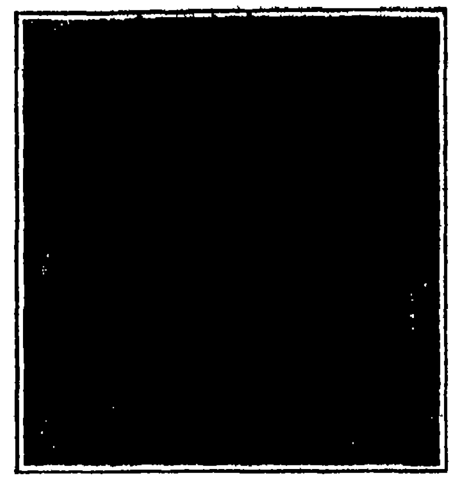
1913 Park Road, Washington, D C

French 155 mm. gun in action

The Masking of Artillery In the Field

Various Expedients Used by Artillerymen to Conceal Their Guns from the Winged Scouts of the Enemy

By Martin Wells



Naval gun hidden in Argonne

THE extensive use of the aeroplane in modern warfare is more than any other factor responsible for the urgent necessity for concealment of pieces of artillery in the field.

Since warfare began to develop tactics that contemplated more and more the use of artillery it has long been a custom to mask batteries in certain positions even when the range of these weapons was not as great as that of the present military rifle. The element of surprise accounted for the deception for when positions of importance were to be held or when armies were so small that maneuvers included ambuscade guns were carefully concealed from the prying eyes of ground scouts and patrols that they might inflict more punishment than if they had been cautiously approached and also reap the benefit of shock to morale. In those days of the muzzle loader, the guns were often kept in a wood drawn back behind bushes and undergrowth, to be pushed by hand to the front at the *denouement*. Emplacements were frequently masked by brush during our Civil War especially along rivers where slight and semi permanent fortifications guarded the watercourse from inroads of lightly armed gunboats or stealthy landing parties.

But the range of artillery has increased almost incalculably since those days of hand-to-hand combat on all occasions. To-day, the artillery almost invariably is to be found well in rear of the line of trenches, scattered in definite arrangement by units and groups.

These artillery units are all connected with one central station through a ramification of lesser points of concentration and the fire of a given sector can be controlled and directed upon any desired point. A complex system of wire communication is established usually with two or more lines in case of damage occurring to one of them. Each battery has its field telephones and from the observation stations range and direction are given with the objective, and the result of fire for correction of aim is at once communicated to each gun employed in the attack or defense.

As the guns owing to their rearward position are therefore secure from ground reconnoisance the aeroplane has taken over the former duties of the cavalry and patrols, which were supplemented by the magnification of field glasses. To-day an aeroplane soars aloft, a mere speck in the blue, and the terrain of the enemy's position unfolds like a wonderful relief map beneath. Equipped with high power glasses, each gun and ammunition supply station would be clearly discernible were they not concealed in some way from view.

Many expedients have been utilized for this necessary concealment. The cover drawing of this issue illustrates a device adopted by forces engaged on the natural geographical line of demarcation between the contending states, where spurs of the Alps, lesser and greater, form canyon and crag in bewildering complexity. To guard the passes, each contending force has been compelled to drag guns up precipitous walls, by man power amplified by mechanical measures.

A battery hidden under heaps of straw

Natural cavities in the sheer rock walls have been enlarged, or new ones blasted out, the embrasure protected and screened by enormous blocks of rock, cemented into a concrete whole. The cover picture shows a gun as being near the entrance of one of these mountain emplacements the liberty taken with fact is merely to show the gun, for normally, it would be deep in the recess, concealed from view and protected by the length of the tunnel from any inimical shot that failed to center directly on the bull's-eye of the small aperture. The shock of discharge in this confined space is so terrific that the gunners must make every possible provision for protection to hearing and nerves.

Afield, behind the battle lines, the artillery chain is concealed by various expedients designed to give as casual and natural an appearance of innocence as possible—especially from aloft.

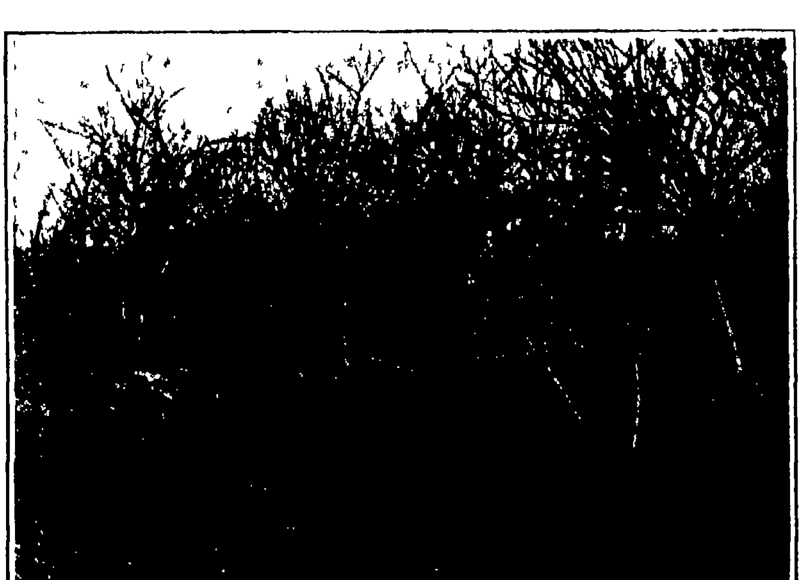
What might present the indisputable appearance from an aeroplane of a field of grain freshly mowed, with the cuttings being stacked, is probably a line of guns above each of which a shock of grain is coned on a skeleton frame. Beside it, carefully covered with deceptive appearing material, and sunken into the ground like the accompanying gun pit is to be found the bomb-proof in which the gun crew lives, eats and sleeps. Sometimes these sheltered earth-caves are 10 feet beneath the surface of the ground.

The reconnoitering aeroplanes have adopted the habit of suspecting everything except a body of water and wherever a protuberance exists within the enemy lines upon location of it by an aircraft, a hail of high explosive shell is apt to land immediately with almost inhuman accuracy.

In the protection whenever an aeroplane is flying above a position it has become the rule for the gun crews to take shelter at once, unless the forward line is engaged in either direct attack or defense. And when an artillery position is once suspected of having been located by the enemy the gun is shifted under cover of darkness to another spot.

Sometimes small houses are used as gun emplacements, the pits being dug through the floors and the guns being fired through hinged ports along the foot of the walls.

Where small ridges occur, as among the hills of the Vosges a cut is sometimes made in them, the top roofed over with the brush and evergreen to appear as though the ridge were continuous and a gun is hid beneath



Almost indistinguishable in the thicket

The ruins give shelter to a formidable gun

Russian heavy artillery in action

Ready to fire at aeroplanes

The gun carriages are painted as neutral a tone as possible, one calculated to blend with the surroundings of the piece. Frequently the paint is mottled, it having been found that broken colors become much more indistinguishable at short distances than solid ones. This neutral tone or mottling permits what seems nearly an inadequate concealment to be in reality very effective. Brush and poles, even branches stripped of leaves, merge into an innocent appearing blur from aloft.

A thicket of evergreen anywhere near a battle position is sure to mask a number of guns, and the thicker the brush, the better.

It has been reported by observers who have been fortunate enough to receive permission to visit the battle fronts, that they were positively startled to almost stumble over the muzzles of concealed guns, great and small, on their walks. A wood that appeared so thin that it could be seen through, sheltered several batteries, and the observers raising foot to step across a log among brush, accidentally brushed it in passing, disclosing a steel muzzle crouched in waiting.

Direct fire is scarcely ever used to-day in warfare, unless in the desperate attempt to stem a tide of defeat. Indirect fire almost entirely is employed, where the guns are concealed from view from their targets or the enemy position safely hidden behind the crest of a hill, far down the slope, or in the rearward valley itself.

The observation stations are often a mile away from the batteries, the posts of the observers being on an eminence, in towers or in an armored nest high in some great tree with a multiple system of wires leading down from the instruments.

These observation posts are much more eagerly sought by opposing guns than even the guns they are placed to direct, for with the destruction of a single, detached observation post, its battery becomes temporarily blind until another post can be established. For this reason, now the batteries are usually connected with several observation points, that the loss of one may not cripple the fire.

Captive balloons are often used behind the batteries or even in advance of them, for observation of fire. Whenever the artillery is to open an attack aeros invariably ascend, to scout over the enemy position and report the accuracy of the fire. Most of the machines now communicate their observations by radio, though there are signals, represented by darts and swoops of the aircraft themselves, that can be made to tell a slower story. Smoke bombs and glittering metal disks are sometimes dropped directly over a position which it is desired to bring under fire, but on the western battle front, at least, each inch of the ground is so well known so thoroughly plotted on the maps that it is frequently unnecessary for the aeroplanes to do more than rise to a convenient height behind their own lines whence they can easily see whether bodies of troops are on the move and warn the guns accordingly.

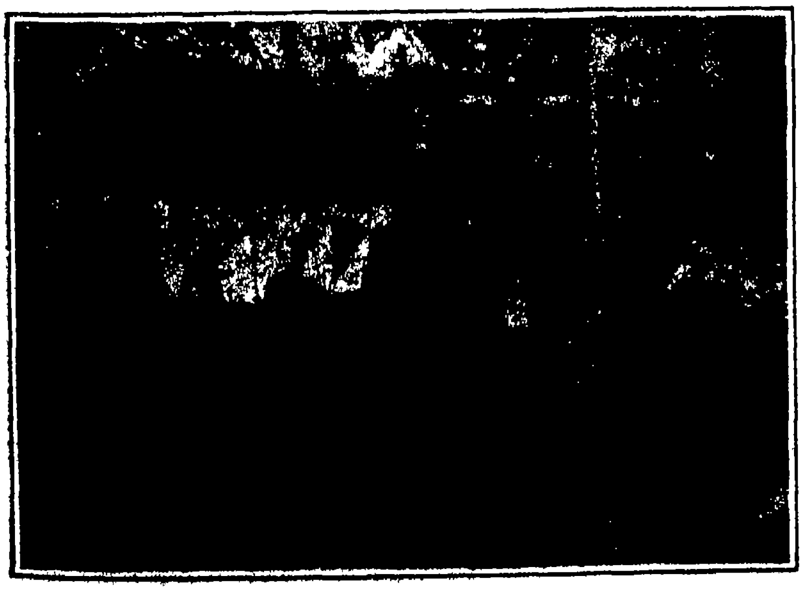
A Russian gun in the Serbian army

The Current Supplement

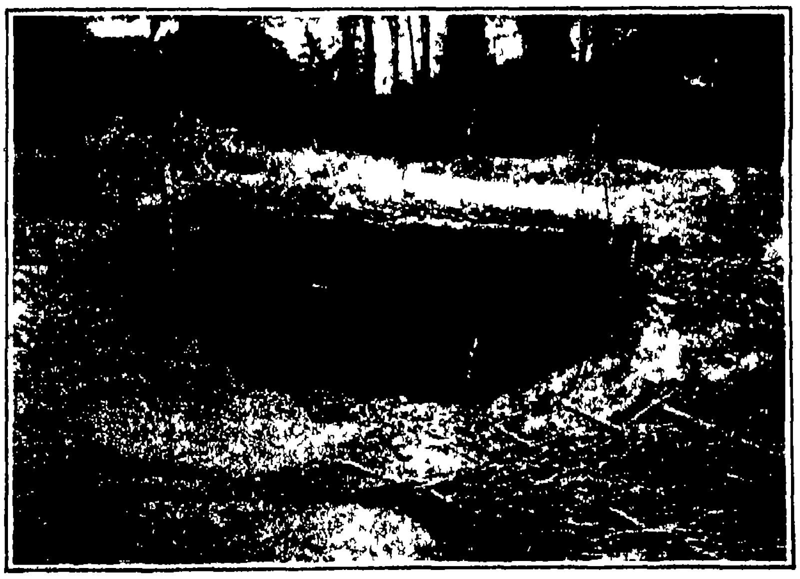
THE conceptions of atomic physics are difficult to understand, and there are many problems in relation to the subject still to be solved. The article on *Mysteries of Matter*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No. 2094 of February 17th, 1916, is a review of some of the properties of the atom which will form a welcome addition to the various articles on the subject that have recently appeared. *Modern Science and War Surgery* is an interesting description of some modern methods of treating the wounded by sun baths and electric heat. It is accompanied by a number of excellent illustrations. *Engineering Education Faults* discusses a subject that is attracting attention among the profession. *Cooperation in Foreign Trade* deals with existing commercial conditions and problems that confront the American exporter, a subject of vital interest to the whole country at this time. *Kapok, A New Textile Fibre* describes the source and processes of preparation of a material that has been found valuable for a number of purposes. The article is fully illustrated. *The Simplex Calendar* is one of the perpetual class in which many will be interested. *Timing With the Rifle* tells of some of the difficulties encountered, and makes suggestions for overcoming them. The paper is illustrated by diagrams. *English Measures of Length* gives an interesting history of the origin and development of many of the standards so generally used in this country. Other articles of general interest in this issue are *Battery Versus Magneto Ignition*, *The Distortion of Iron Castings*, *The Locomotive and the Revolutionist*, *Imitation the Pioneer of the Genuine* and *Emulsions and Emulsification*.

Artificial Silk

WHAT appears to be an original method of producing artificial silk is due to the Japanese inventor, Kishi. The process is based on the use of the commercial substance known as chrysalis oil or essence and the important point is that this oil shall be refined by a special method so as to have it in the pure state. The substance thus obtained is mixed with a solution of nitro-cellulose, which latter comes from mulberry bark or other parts of this tree, and he specially recommends the use of mulberry paper. A solution of cellulose of this origin is obtained by dissolving in a proper solvent such as alcohol and ether. The silk fibre is made from this liquid on the customary process by forcing it through a very fine hole, and he claims that such artificial silk comes the nearest to the original in lustre and it has great flexibility.



Carefully concealed from the eyes of aviators



One of the French 75 mm. guns hidden in the Aisne

Strategic Moves of the War, February 12th, 1916

By Our Military Expert

THE long looked for activity on the western front seems on the point of culminating in a stroke of some description, whether only for the purpose of enabling Germany, if successful to secure a firmer footing against an expected assault in force or whether it is the institution of another attempt to break through to the channel or Paris

If it is one of the latter objectives which actuates the movement, at once it challenges attention to the magnificent organization, resource and daring of the Kaiser's legions, which, surrounded on all sides, with every front exposed to risk more or less grave and despite the tremendous losses which have been sustained since the initiation of the war, and it makes the curious wonder where on earth the men can come from to warrant the attempt.

It has been reported by American observers returning from abroad where they have had an opportunity to make rather accurate estimates that for a direct attack upon any of the solidly held lines the losses to be met will run, for the assailants, between twenty and twenty five thousand men per mile of front On the eastern front a slightly less average percentage may be estimated, through the opportunity though slight, for maneuver In addition to the losses that must be sustained, at least seven thousand men per mile must be provided to hold the position once it is taken Therefore, an attack to be endowed with the elements of success, should be in strength of between 27 000 and 30,000 men per mile of front.

The average telling range of field artillery may be assumed as about 7 000 yards—about four miles If then, a successful attack is to be delivered it must be on so broad a front that the artillery which will be brought to bear against it from the flanks of the broken line will not be able to reach at least a part of the cleared line. Twice four miles is eight miles—and a gap of two miles in the middle of the line that may be held fairly unmolested makes necessary a front of at least ten miles for the assault

Suppose we split the difference and call the strength per mile for the assault 30 000 men Multiplied by ten miles, the result, 300 000 men, at least must be massed on this comparatively narrow front before the factor of success can be counted upon.

Following the wanderings of the western front the distance is approximately 460 miles—each yard of which is held and must be held Probably 3 000 men per mile can defend this on the average, therefore a minimum of 1,380,000 must be actually on the line on each side, or immediately in rear to furnish local reserves and supports. But, in addition at least as many more must be within call general reserves that can be shifted from point to point to strengthen a threatened sector make local assaults or initiate an offensive return Therefore at least 2,760,000 men must be normally considered as on each side of the western battlefront

If a general offensive is to be launched, even only on a ten mile front in an effort to break the line and turn connecting positions by the securing of some strategic point, these 300 000 men must be provided in other words about 24 000 men per mile of attack front in addition to the forces already engaged at that part of the line

If these are taken from the general reserve other parts of the front must be proportionately weakened if they come from another theater of war, the same obtains It is therefore much more desirable that these troops for assault be brought up from the interior or that new troops replace veterans on another line to release the latter for the more gruelling task of storming

Let us consider some figures on relative strength Without going into details of composition, actuaries tell us that the nations of the Central Powers have a total population of 140 000,000 from which a man power, estimated on a certain percentage of the population varying from six to twelve per cent due to local internal conditions, of 14,800,000 men is available for the battle line.

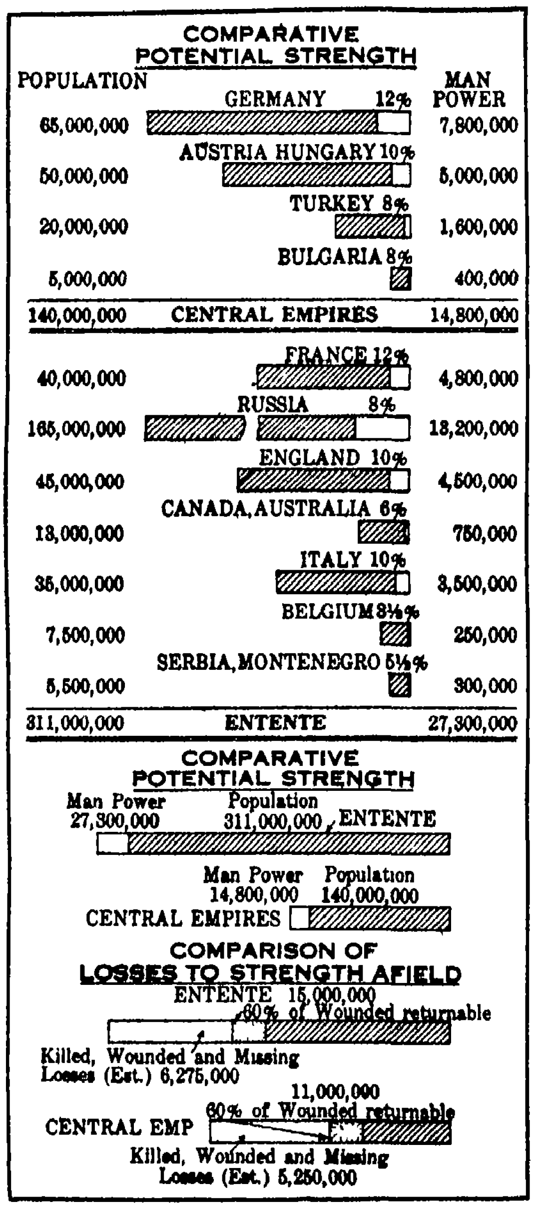
Of this strength it is estimated that there are now 11 000 000 men of Teutonia in the field, about as follows Germany 6 000 000, Austria Hungary, 3,700,000, Turkey 1 000 000, Bulgaria, 300,000.

This leaves Teutonia a reserve as yet not actively drawn into the conflict of 3 800 000 unaccounted for

Eliminating Germanic forces in the Balkans, the length of line occupied by German troops fronting Russia is approximately the same as on the western line though it is to be doubted if as many German men are fronting Russia as are massed in France and Flanders. Counting them equal however, for convenience sake, 5,520 000 German troops are in position on the two lines leaving of the 6,000 000 men afield but 480 000 available for special attacks And when they are once gone, if unsuccessful, there remains very little man power to replace them.

These figures have taken into account no losses. Some idea of the horrible losses sustained in attack may be gained when it is considered that in the British and French offensive at Loos alone the admitted Entente casualties in killed wounded and missing amounted to 100 000 men—and that on comparatively small fronts

The full losses sustained by the Teutonic allies are estimated to amount now, for the entire war, in killed, wounded and missing to something like 5,250 000 men, leaving available for action the difference between this number and the greatest estimated strength of 11,000,000—or 5 750 000 plus that percentage of wounded who have been or will be able to return to the front, possibly sixty per cent of the total As the number of wounded has so far proved to be more than the sum



Resources in men of the warring nations

of the deaths and captures, it may safely be estimated that at least 1,800,000 men wounded and recovered may be counted among those available for duty With the untouched strength these should give available to-day about 7,550 000 men for Teutonic activity It seems as though this were hardly enough for the task of general offensive.

On the other hand, the Entente nations, with a population of 311,000 000 (excluding Japan from all calculations) have a potential man power strength of 27,300,000 Russia, of course, with her vast population, is accountable for about fifty per cent of this number. But her quota has been figured on a basis of but eight per cent—and she is accredited with only 7,000,000 men afield out of a possible strength on the eight per cent basis, of 13,200,000—about half, in fact.

The Entente strength afield is counted as follows. England, 2,000,000, France, 3,500,000, Russia, 7,000,000, Italy, 2,000,000, Serbia and Montenegro, 250,000; Belgium, 250,000, without counting losses.

The Entente losses are greater than those of the Teutons, especially in prisoners, for the Russ losses by capture when their ammunition failed them and the German armies were running wild over Poland and Galacia, were stupendous In round numbers, the Entente losses are estimated as follows: England, 550,000, France, 2,000,000 (although M Longuet, a French Socialist Deputy, is reported as having placed them at the stupendous total of 2,500,000), Russia, 3,000,000, Belgium, 100,000, Italy, 500,000, Serbia and Montenegro, 125,000—a total of 6,300,000. This should leave the Entente with 8,700,000 men, plus the wounded returned to duty, about the same as Teutonia's in number—less, in proportion to the loss, through excess in captures—1,800,000, leaving thereby for active service at the present, about 10,500,000 men.

It will be seen that in proportion to present strength, the Entente forces are numerically stronger than those of their opponents, the advantage increasing rapidly as the losses on both sides mount higher with each month of warfare, and while Teutonia is estimated as having drawn upon her potential man power to within 3,200,000 of its limits, the Entente has summoned but 15,000,000 men out of a potential strength of 27,300,000—leaving 12,300,000 as yet untouched

The deduction is entirely obvious, if the war is prolonged until one side is worn away, even if the Entente losses are somewhat in excess of those of Teutonia, the time will come when, theoretically the Central Powers will not have a man to place on the line while the Entente will yet have millions.

There is a physical limit to the number of men that can occupy a given space—on the line of battle, for instance, and so far, Teutonia has had and still possesses sufficient numbers to man her defenses Her organization of the keystone of the federation, Germany, was well nigh as perfect as human military ingenuity can build, not only was general military service the order of the day, but all railway and commercial activities, as well as the system of finance were directed to the end of supporting the bayonet. Germany was able to distribute here instructors with their sound methods, among her allies of lesser military ability, with the result that from start to finish the closer knit federation of Teutonic strength has triumphed to the limits that modern warfare sets for a drive against solidly entrenched lines.

On the other hand, the Entente powers, while possessing a tremendous preponderance of man power, were not prepared, were not organized for war—and the present war far exceeds in size and ferocity what any man had considered as a possibility—and they have had to spend the entire time intervening since the outbreak of hostilities in just barely holding off the powerful assaults of their foemen while arming

Once the arming is complete—and observers tell what common sense suggests, that it is progressing rapidly—let the losses give and take, let them wax high to shocking proportions, and vastly superior numbers, properly armed, must inevitably tell

It looks very much as though the beginning of the end—which may be delayed a year or more—is in sight.

Decorative Process

AN industrial process has been in use for producing decorative ornaments which consists in the employment of a first layer of mortar preferably of a dark color, upon which is applied a second and thinner layer of another and usually lighter color, then a suitable design is scratched through so as to uncover the second layer, thus producing an effect in two colors. But such material has been very fragile up to the present and would not stand the wear An improved process consists in the use of an underlayer in cement mortar or ceramic paste upon which is put a second layer of the same, then the design is scratched through as before. The material in the shape of a brick, tile, or slab is then baked in the furnace so as to become hard, and in this way the decoration can be used without fear of damage from weather or other causes.

Sugar-Beet Regions of the United States

THE Bureau of Plant Industry states in its last annual report that it has been making a general survey of the recognized sugar-beet sections of this country, with a view to determining whether and to what extent these regions are well suited to the industry. The investigation included not only a study of the soil, climate, and water conditions, but also of labor, marketing, crop competition, and other factors of a general nature bearing on the problem. It appears that there are 77 existing sugar-beet sections in 17 states, and that the majority of these are well located with reference to the factors that make for success.

A New Process in the Art of Filtration

WHAT is undoubtedly an important step forward in the art of filtration is due to the efforts of F K Atkins and his sons of New York City, who have succeeded in evolving two types of centrifugal filter presses that possess many unique features and make possible a new and improved method of filtration

The first type of Atkins filter press, which will be designated as type A for the sake of convenience, comprises essentially a revolving bowl containing the filtering elements, the bowl being closed up when in operation so as to receive under pressure the liquid to be filtered The filtering elements, which revolve with the bowl, are covered top and bottom with filtering medium, thus exposing a large percolating area to the liquid supplied under pressure The filtering medium may be of any suitable material—filter cloth, wire cloth or any other material best adapted to the liquid to be filtered

In the type A machine the unfiltered solution is fed in through a valve-controlled pipe at the top, from a main or under pump pressure Since the bowl revolves at comparatively low speed, to the supply pressure for forcing the liquid through the filtering medium there is added that due to the rotary speed imparted to the materials under treatment, as well as that due to a vacuum condition produced in the filtering elements, resulting from traps in the nozzles through which the filtered liquid is centrifugally released When aeration is desired, it is accomplished by means of sprinklers in the nozzles

The disk like filtering elements revolving at a somewhat higher speed than the unfiltered liquid in the bowl, causes the continual scouring of the solids from the surface of the filtering elements, the solids being deposited on the bowl wall by the agency of centrifugal force This feature of the machine permits of continuous filtration with a comparatively clean filtering medium, in contradistinction to existing methods, which, as an unavoidable feature of their operation, are constantly building up a cake of solids on the filtering medium, which hampers the percolation and reduces the capacity in direct proportion to the density of the cake

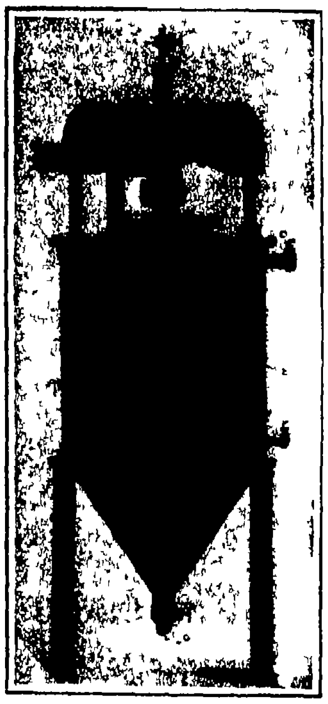
An annular valve surrounding the bowl and actuated by a wheel opens up outlet ports in the periphery, through which the solids are centrifugally released while the machine is in operation Means are also provided for cleaning the filters by surface- and reverse-washing within the machine

For a better understanding of the action of the machine the accompanying illustration of the type A filter press may be referred to In this drawing, *H* is a yoke, *I* is the gate, and *J* the connecting posts. *K* represents the outlet ports for releasing the solids, when the gate is raised, by the centrifugal force *L* indicates the wire cloth covering of one of the filter elements, and *M* the expanded metal which acts as the reinforcement. *N* are the filter elements which are overlaid with filter cloth and revolve with the bowl *O* is the outlet for the filtrate, while *P* is the outlet for the solids.

The conventional milk and cream separator, it will be recalled, employs centrifugal force only for the separation of the two liquids, but the centrifugal filter press, in the way of contrast, employs both centrifugal force and filtration concurrently, in this way achieving the rapid separation of the solids from the liquid.

The type B filter press is of simpler design than the type A, although no less efficient in applications for which it is intended. It comprises a pressure tank provided with a removable cover, a hollow spindle, mounted to permit of rotation; hollow, disk-shaped filtering elements attached to the hollow spindle so that they may rotate with the latter, through which the filtered solution is drawn off, and radial pipes and traps. The arrows in the accompanying illustration indicate the direction in which the liquid travels The liquid to be filtered is fed into the machine through a valve-controlled pipe, while the solids are collected in a hopper-shaped chamber at the bottom, from which they may be drawn off at intervals. Means are provided for reverse- and surface-washing of the elements within the machine The type B machine is of remarkable simplicity and in comparison with stationary filters has large capacity

Partly broken away view of the Atkins filter press, designated as type A



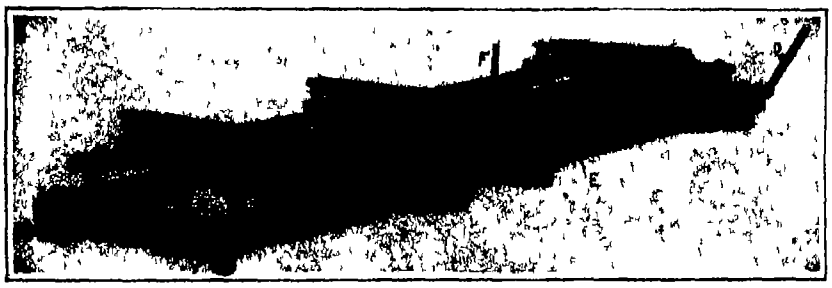
Sectional view of the new filter press, known as the type B

The parts of the type B filter as shown in the accompanying sectional view, are as follows

A is the inlet for reverse washing water supply *B* the liquid trap which gives the vacuum pressure, while *C* is the trough for receiving the filtered solution as discharged from the machine *D* presents the inlet for the unfiltered solution *E* are the filter elements covered with filter cloth which are attached to the hollow shaft *F* is the inlet for surface washing of the filter cloth while in the machine, and *G* the draw-off for solids

Both types of Atkins filter presses are designed to employ wire cloth as the filtering medium This material is readily cleaned under the centrifugal influences and has a much longer life than the ordinary filter cloth thus greatly simplifying the work and reducing materially the cost of filtration

The uses of filter presses of the foregoing mentioned types are many, of which the following may be mentioned In filtering all the different solutions in chemical works and the liquids in sugar refineries and in breweries, in dewatering the slimes in cyanidation in filtering the inflow to the textile mills and the effluent therefrom for the recovery of leadite, in round houses boiler and locomotive works, paper mills, ice plants, bath houses, hotels, hospitals public buildings and blocks, and in filtering water for drinking purposes. Mounted on an automobile truck, the filter presses may be used for filtering water for the use of soldiers in the field and for construction gangs generally Small types which are being designed for use in homes, using stone as the filtering medium, will insure a supply of pure and safe drinking water to households



Details of the cradles

The "Hispaniola" in "Treasure Island," which rolls and pitches at will

"Treasure Island's" Realistic Ship

IN 1881, when Robert Louis Stevenson was staying at Braemer in Scotland, he wrote "Treasure Island" for his twelve-year-old step-son, Lloyd Osbourne The cold was intense, everyone went to bed to keep warm, and Stevenson with the rest sat up regularly in bed, writing on a board on his knee "The Sea Cook, or, Treasure Island A Tale of the Buccaneers. He had no conception of what was to be the outcome of this masterly creation It soon dropped its fore title and became "Treasure Island"

For two generations old and young have been entranced by the interest of the plot and the sparkle of the dialogue, and above all by the rapid fire action which carries us along from chapter to chapter irrespective of the bed time hour Now we have in New York at its quaintest theatre (The "Punch and Judy") holding an audience of only 290, a beautifully sustained production with all parts played by artists of rare ability under the direction of Charles Hopkins whose wife gives a charming interpretation of "Jim Hawkins" the cabin boy on the eventful expedition The first scene opens at the "Admiral Benbow" with Bill Bones singing the well known pirates refrain,

> Fifteen men on the Dead Man's Chest—
> Yo—ho— and a bottle of rum!

Then we come to the quay at Bristol when the awful pirate crew including Long John Silver, who contributed the first part of the name to the first title, ships before the mast on the "Hispaniola" and the lines are cast off In time we arrive at Treasure Island, in

(Concluded on page 208)

The Motor-driven Commercial Vehicle

Conducted by VICTOR W PAGE, M. S A E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles

The Electric Taxi-Cab

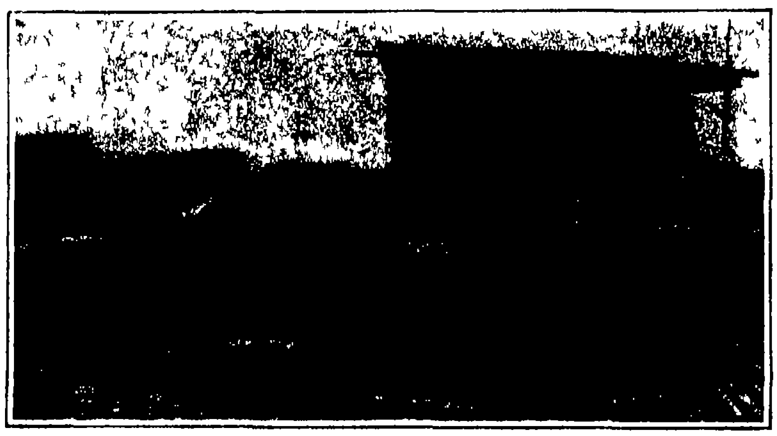
AN electric taxi-cab service has been in successful operation in Detroit for several years and they have demonstrated that they are entirely practical and very popular with the public About two years ago one electric cab was built as an experiment and owing to the lack of coöperation between the taxicab company and the manufacturers of electric vehicles the company was forced to develop its own designs. A cab has been constructed which follows the lines of the conventional gasoline taxi-cab in outward appearance It has a wheel base of 121 inches, the interior of the cab body proper has a space about 68 inches long and 50 inches wide which enables the vehicle to carry from four to five passengers very comfortably The body is a limousine type as experience demonstrated this to be preferable to the landaulet type The operating cost has not exceeded $0 20 a mile, this including driver's wages, overhead, tire expense, garage expense depreciation and, in fact, every expense that is incidental to the operation of the taxi cab business The company has decided to depreciate this model over a period of ten years which is twice the reputed life of the gasoline engine propelled cabs In order to operate the electric cabs 24 hours a day, charging boxes have been installed at the cab stands so that whenever the cabs are standing idle they are being charged Special cord pneumatic tires are used which are said to not only increase the mileage, but to materially reduce tire expense as well as the amount of current consumed It is said that these cabs have a maximum speed of 25 miles per hour which is sufficient for the requirements of an urban taxi-cab service

Truck as Track Wrecker

A FIVE TON gasoline truck equipped with a winch and derrick was recently put to a novel task in Cleveland A stretch of highway was being built and before finishing the road surface it was necessary to remove an unused length of car track The method by which the rails were lifted was not only very simple but was accomplished with a minimum of time and labor A special pair of rail lifting tongs was utilized to grasp a length of rail and was attached to the boom of the derrick The winch, which was operated by the engine power, was started and the rail easily lifted from the ties After demolishing a section of the track the truck loaded the rails on its own carrying platform, a feat that was easily accomplished by the derrick integral with it

Motorizing Horse-Drawn Fire Apparatus

THERE are many communities having very efficient and practically new horse-drawn fire apparatus that are considering motorization in order to keep up-to-date There is no question at the present time regarding the effectiveness of mechanical power for propelling all forms of fire fighting apparatus from the chief's lightest runabout to the heaviest water tower or hook and ladder truck There are a number of excellent automobile fire trucks offered at the present time these incorporating all of the latest approved features of automobile engineering combined with the latest developments in fire apparatus construction. Appropriations for the purchase of new apparatus are not easy to obtain when the authorities realize that their horse-drawn equipment is much too good to be sacrificed on the second hand market. A large business has been developed in converting horse-drawn apparatus to motor-driven by means of front wheel drive tractors These are really two-wheeled fore-carriages in which the wheels combine directive and tractive functions The entire power plant, transmission system and controlling elements are incorporated with the tractor, which is so designed as to be easily connected to the frame of a steam pumping engine or other apparatus. The attachment can be made at relatively small expense, because the only charge is for the power plant and auxiliary devices, whereas in buying new apparatus the department must pay for the fire fighting part as well as the propelling mechanism. Two examples of converted horse-drawn apparatus are shown in accompanying illustrations One of these is a steam pumping engine, the other is a water tower



Truck equipped with special platform to handle lumber expeditiously

Five-ton truck used in track wrecking

Horse-drawn fire apparatus motorized with two-wheel drive and steer tractor

Motor Truck Queries

S C T writes I would appreciate your views on the following I have one 30 h p. 1911 model touring car which I desire to change into a one-ton truck, if possible Kindly furnish estimate of cost to change What gears do you have to change? How much does the horsepower decrease? Any other information that you can think of that will help us.

Answer We do not believe that it will be practical for you to change your car into a one-ton truck unless you make some radical changes in the construction. In the first place, the frame, axles and wheels are not strong enough to carry a load of a ton. You would experience considerable trouble, due to failure of important and costly parts, and the cost of making the change would be nearly as much as that of purchasing a second hand truck of the capacity you desire While you have ample engine power, the other parts of the chassis are not sufficiently strong You can, however, make a very efficient delivery wagon of about 1,250 pounds capacity without materially changing the construction. The frame should be strengthened by means of truss bars under each side rail and auxiliary or overload springs of the coil type should be placed between the members of the full scroll elliptic springs now on the rear of your chassis. It will not be necessary to change any of the gearing to obtain satisfactory service, as you have a large margin of power available. An express type body can be made by your local wagon builder for about $50 00 and considerable carrying capacity obtained by allowing a 2 foot overhang at the rear end The rear axle could be provided with a heavier truss rod to advantage and oversize tires fitted to the rear wheels All of the changes enumerated, including repainting, should not cost over $100 00

E W M writes During the recent cold snap we had the misfortune of having the water in our truck cooling system freeze and not only bursting the radiator but also the water jacket of our four cylinder block cast motor We have had a discussion relative to the best method of repairing the latter My partner insists that a mechanically applied patch will be preferable to repairs by the oxy acetylene process because this is apt to distort the cylinders. The water jacket wall is not seriously damaged, there being a crack about five inches long in it. The cylinder walls are not damaged at all. What do you advise?

Answer While the autogenous or oxy-acetylene process has been developed to a point of great efficiency at the present time, it would seem that satisfactory results would be obtained by the mechanical patching method in this case, as it would be less expensive than welding and not requiring the use of a hot flame as the welding process does. Before cylinders are welded it is necessary that they be carefully preheated prior to the application of the welding flame If this is not carefully done the bores of the cylinders are apt to be distorted. There are two common methods of repairing cracked water jackets without recourse to a welding flame. In either case

(Concluded on page 208)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the Scientific American

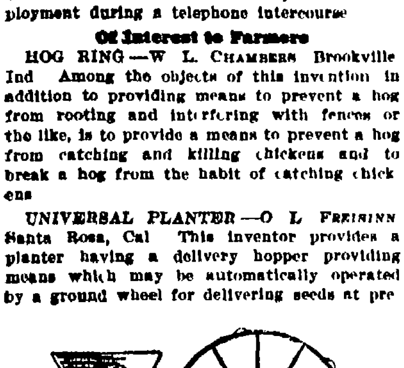
Electrical Devices

RECEIVER HOLDING ATTACHMENT FOR TELEPHONES.—W. A. DELANO and ELEANOR R. BELMONT. Address the former 4 E. 39th St., New York, N. Y. This invention relates to attachments to telephones for holding the telephone receiver in such relation to the transmitter that a person can use the telephone without the necessity of supporting the receiver to the ear by the hand, and as a result both hands will be free for any desired employment during a telephone intercourse.

Of Interest to Farmers

HOG RING.—W. L. CHAMBERS, Brookville, Ind. Among the objects of this invention, in addition to providing means to prevent a hog from rooting and interfering with fences or the like, is to provide a means to prevent a hog from catching and killing chickens, and to break a hog from the habit of catching chickens.

UNIVERSAL PLANTER.—O. L. FREISINN, Santa Rosa, Cal. This inventor provides a planter having a delivery hopper providing means which may be automatically operated by a ground wheel for delivering seeds at predetermined spaced intervals, provides a planter having an automatically operable device for planting the seeds at spaced intervals and means for covering the seeds, and provides an arrangement whereby the planting rows may be spaced at desired distances apart.



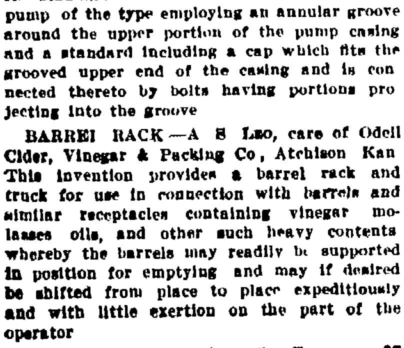
UNIVERSAL PLANTER.

Of General Interest

PUMP ATTACHMENT.—W. S. BRIGGS, 1106 Farman St., Omaha, Neb. This invention relates more particularly to the connection between the upper portion of a pump casing and its standard, either a windmill or a hand pump, of the type employing an annular groove around the upper portion of the pump casing and a standard including a cap which fits the grooved upper end of the casing and is connected thereto by bolts having portions projecting into the groove.

BARREL RACK.—A. S. LEO, care of Odell Cider, Vinegar & Packing Co., Atchison, Kan. This invention provides a barrel rack and truck for use in connection with barrels and similar receptacles containing vinegar, molasses, oils, and other such heavy contents, whereby the barrels may readily be supported in position for emptying and may if desired be shifted from place to place expeditiously and with little exertion on the part of the operator.

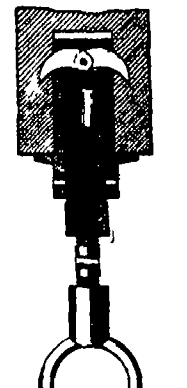
LATHERING DEVICE.—G. ZINGALI, 37 Glenridge Ave., Montclair, N. J. The invention relates to barbers' appliances and has particular reference to a means for generating and dispensing lather. It provides a means for supplying lather to a customer's face in a most sanitary manner, the lather being supplied to the face without the necessity of any part of the apparatus coming into immediate contact, and whereby the danger of contamination due to previous contact with another customer is avoided.



LATHERING DEVICE.

PROCESS FOR THE MANUFACTURE OF BROWN WOOD PULP AND HALF-CELLULOSE FROM RESINOUS KINDS OF WOOD.—J. AKTSCHOURIN, Aktschourin Tupik, Russia. In the present improvement the invention enables the alkali which serves for the treatment of the resin product to be completely utilized and the object of the invention is also to obtain a product which is itself valuable in the form of a brown wood pulp.

PIPE HANGER.—L. A. GRIMES, 97 Day St., Orange, N. J. This invention has particular reference to devices designed particularly for supporting pipes for automatic sprinkling systems in buildings. Obviously, however, the hanger means may be employed for supporting other devices than water pipes. It provides an anchoring means adapted to be readily and easily applied to floor beams or joists in a positive and secure manner, and provides a means for easy and effective inspection whereby the inspector may determine whether the work of installation has been properly performed.



PIPE HANGER.

ICE CREAM DISHER.—S. E. SURFACE. Address M. O. McLaughlin, Pres. York College, York, Neb. This invention relates to an ice cream disher, and one of the principal objects thereof is to provide a disher or scoop which may be used to advantage in filling cones without wasting the cream, as well as being useful in measuring ice cream for dispensation in dishes.

CANDY PACKAGE.—L. HIRSCHFELD, 416 W. 45th St., New York, N. Y. The purpose in this case is to provide a package formed of individual or separate sections united by paraffined joints to prevent the sections from sticking together and whereby the individual sections can be easily separated when consuming the candy.

BUILDING CONSTRUCTION.—A. DUARTE. Address Humberto Barcho, 904 Ave. P, Brooklyn, New York, N. Y. This invention provides a construction wherein the supporting walls are completely formed and anchored by masonry and provides matched parts which may be assembled, and when assembled anchored in service by means of a pouring setting cement and key members through which the setting cement extends.

GUN CARTRIDGE AND PROJECTILE.—E. E. GREGORY, Lewisport, Ky. This invention relates to a device for use in gun cartridges to serve as a wad and gas-check in shooting stream line bullets or other projectiles including bombs. The device is cup-shaped and it may be made in various sizes and modifications in regard to details of shape and construction.

BUILDING CONSTRUCTION.—DR. ARTHUR B. COON and A. VAN DE SANDT. Address the former, 20 Urquhart Bldg., Little Rock, Ark. This invention has for its object the provision of a new form of anchor and tie for connecting an ornamental facing to a building of brick, stone, cement or the like, of simple construction and low cost, yet efficient for the purpose.

PROCESS OF PRODUCING SOLUBLE SALTS OF ALUMINUM.—M. W. COOLBAUGH and E. H. QUINNEY, Rapid City, S. D. Address Schrardes and Lewis, Lawyers, same place. This invention refers to improvements in processes for producing soluble salts of aluminum from kaolin and other silicious and argillaceous earths, rocks, or minerals containing no potash or not sufficient potash to make its extraction of commercial importance, in which compounds of aluminum exist in an insoluble form.

CONCRETE BURIAL VAULT FORM.—L. P. DUNN, 1527 South 20th St., Terre Haute, Ind. The invention relates to molds for making burial vaults, watering troughs, etc., from concrete and other plastic materials, and has for its object to provide a mold of steel plates and angle iron which may be quickly adjusted in length, width and height whereby to permit of the formation of structures of different sizes and dimensions.

UTERINE SUPPORT.—C. G. HALL, Washington, D. C., care of A. Pfeifer and Brother, Little Rock, Ark. The invention has for its purpose the provision of a support that may be worn with comfort and convenience and that may be adjusted to suit varying conditions. It may be easily removed and replaced, and will afford a perfect support.

Hardware and Tools

COUPLING FOR CONNECTING PIPES AND FAUCETS TO RECEPTACLES.—W. M. St. ELMO, San Juan, Porto Rico. The coupling is constructed with a hollow shank having a point at its end for penetrating the receptacle, there being a plurality of levers fulcrumed around the shank, arms of which close the openings in the sides of the shank when the shank is pushed through the opening in the receptacle, the other arms of the levers being adapted to be engaged by a nut meshing with a thread on the shank for holding the first mentioned arms of the levers against the inner side of the receptacle while the nut having a gasket, is turned home against the outer side of the receptacle.

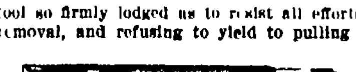
LOCK AND LATCH.—J. O. KAPADER and F. KERR. Address the former, Fort Bidwell, Cal. The invention relates to means for preventing unlawful or unauthorized entry into buildings or rooms or closets therein, trunks, chests, etc. A further intent is to engage a key or tool used in such unauthorized entry and hold the same against removal by locking the lock bolt against movement in either direction.

PIPE CLAMP.—G. H. NAYLOR, 720 Wallison Ave., Nevada, Mo. In this case the invention relates to pipe clamps and has reference more particularly to a flexible pipe clamp which comprises a flexible member adapted to encompass pipes of different diameters with means for gripping or releasing the flexible member from the device.

HOSE PIPE COUPLING.—H. FORSMAN, c/o T. J. Borell, Box 9, R5, Fresno, Cal. The invention provides for uniting hose sections, provides means for locking said sections in united relation, provides means for drawing the sections together to prevent leakage there-of, and provides means for locking the sections in service relation.

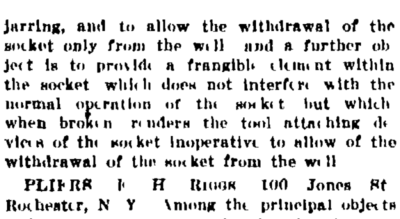
CLASP.—H. F. GRABAU, 351 E. 83rd St., New York, N. Y. The invention has for its general objects to improve and simplify the construction and operation of a clasp so as to be reliable and efficient in use, comparatively simple and inexpensive to manufacture and so designed that a firm grip can be obtained by the clasp.

TOOL FISHING SOCKET.—C. A. RASMUSSEN and R. M. CLARK, care of Burmah Oil Co., Ltd., Khodaung, Yenangyaung, Burmah, India. An object in this invention is to construct the socket so as to be readily detached from a tool so firmly lodged as to resist all efforts at removal, and refusing to yield to pulling and jarring, and to allow the withdrawal of the socket only from the well, and a further object is to provide a frangible element within the socket which does not interfere with the normal operation of the socket, but which when broken renders the tool attaching devices of the socket inoperative to allow of the withdrawal of the socket from the well.



TOOL FISHING SOCKET.

PLIERS.—F. H. RIGGS, 100 Jones St., Rochester, N. Y. Among the principal objects which the present invention has in view are to provide a tool for drawing the ends of wire or similar articles together, to provide hand operated pliers disposed in paired arrangement adapted for contracting or expanding the ends of articles gripped thereby, and to provide means for expanding and contracting the interval between individual pliers.



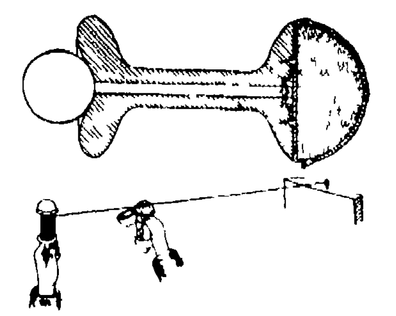
PLIERS.

GRASS TRIMMER.—C. C. LILLEN, 530 Dupont St., Roxborough, Philadelphia, Pa. This invention provides a trimmer which may be employed in compact spaces incapable of accommodating a lawn mower or other wheeled grass cutting implement or mowing machine, as well as providing for the facilitation of cutting of grass, hedges, or the like in such places where the usual shears are used, by avoiding the tedious and tiresome operation incident to the use of the latter and also permitting the running of the device along a straight or rectilinear line of grass or hedge to be trimmed so that a true cut can be made.

PERMUTATION LOCK.—S. PLAZEK, 402 E. 72nd St., New York, N. Y. The lock is more especially designed for use on satchels, valises, trunks, doors and other articles and devices, and is arranged to permit of engaging the keeper with the locking bolt irrespective of the permutation mechanism of the bolt and to prevent disengagement and unlocking unless a person is in the possession of the combination of the lock.

RECEPTACLE HOLDER.—C. H. CHRISTENSEN, 4037 Hirsch St., Chicago, Ill. This invention relates to receptacle holders or supports, and more particularly to a device for detachably suspending a can or other receptacle for containing washing powders and the like in a convenient place where the same is readily accessible when it is desired to use the contents thereof.

CHALK LINE SPOOL.—F. E. BAILEY, 120 Flower City Park, Rochester, N. Y. This invention is an improvement in spools or rotary holders for chalk lines which are used by carpenters. The holder comprises a flanged spool



CHALK LINE SPOOL.

having a chalk holder proper secured to one end, a central shaft on which the spool is mounted and secured rotatably, said shaft having one end constructed as an enlarged disk as and for the purpose specified.

Household Utilities

BRACKET FOR GLASS PERCOLATORS.—R. S. DAMLING, 29 Murray St., New York, N. Y. This improvement has reference to percolators and particularly to percolators of the glass type and has for an object the provision of an arrangement of bracket for holding the parts together and for allowing a proper manipulation of certain of the parts.

APPARATUS FOR AGITATING MATERIALS.—J. H. CENTER, 13 Colden St., Newburgh, N. Y. This invention provides an apparatus more especially designed for use in households as a flour sifter, dough mixer, egg beater, ice cream freezer and the like, and arranged to allow convenient and quick interchange of the parts to permit using the apparatus for the various purposes.

WASHBOARD.—J. W. HOLLAND, 252 Central Ave., Newark, N. J. This invention relates to a washboard provided with yielding means against which the person using the board may bear so that the said means will yield to the pressure of a washerwoman instead of offering an unyielding resistance which is liable to result in injury.

FLY TRAP.—G. C. SKELTON, care of C. P. Lord, 718-719 Kitridge Bldg., Denver, Colo. This invention relates to an improvement in fly traps. One of the principal objects of the invention is to provide a fly trap particularly applicable to a window screen, the trap being of such a nature as to be built in the door or screen to form a part thereof.

NAPKIN HOLDER.—C. H. RUTHERFORD, Jerome, Ariz. In this patent the invention is an improvement in napkin holders and has for its object to provide a holder of the character specified capable of being supported from the waist of the wearer and having means for supporting a folded napkin.

BRACE FOR WINDOW FOOD BOXES.—A. F. BERNARDO, 511 E. 78th St., New York, N. Y. This invention relates to improvements in window food boxes and has to deal more particularly with an improved brace for rigidly holding the window box in either of its extreme positions without danger of the wind causing it to swing back and forth.

SLACK ADJUSTER FOR CLOTHES LINES.—F. T. DUNN, 71 William St., Wallingford, Conn. The inventor provides a pulley of peculiar construction journaled in a U shaped frame of novel form adapted particularly for cooperation with said pulley, one end of the frame being adapted to be secured to a building or other fixed object or to one end of a looped line, while the loose end of the line is adapted to pass partly around the pulley and then be extended laterally for cooperation with the frame.

DISPENSING SUGAR BOWL.—M. D. GREEN, 1191 E. 19th St., Portland, Ore. This invention provides a bowl with means for preventing the admission of insects, dust, or other foreign matter thereto, and provides a dispensing apparatus simple in construction, readily cleaned and easily attached to the body or containing receptacle of said bowl.

Machines and Mechanical Devices

SLIP JOINT FOR SUCKER AND TIE RODS.—J. B. DUNLAP, 418 N. Boston Ave., Tulsa, Okla. The invention provides a joint so arranged that the rods may be connected directly by moving them laterally with respect to each other and without the use of screw threads or the like, thus dispensing with the time necessary to screw or unscrew the rods and with the danger of stripping the threads and with the liability of loose joints from worn threads.

CABLE EXCAVATOR.—A. D. HADSELL, Commercial Trust Bldg., Philadelphia, Pa. Among the objects of the invention is to provide in combination with a slack cable trackway adapted to be raised or lowered and tightened or slackened, a special and novel type of bucket adapted to be dumped either automatically or semi-automatically by simple manipulation of the power attachments.

GREASE CUP.—F. M. EBB, 22 Morris St.

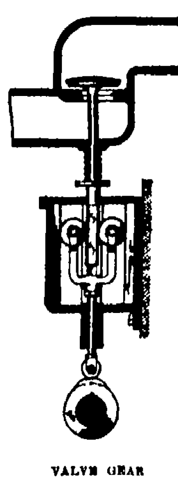
Jersey City N J This improvement has reference to grease cups and relates more particularly to a cup retainer intended to prevent the loss of the cup proper by the vibration of the machinery to which the grease cup is attached and which may cause the cup to move on its plunger

CLUTCH—A W WARREN 1440 E 15th St Brooklyn New York, N Y In this case the invention relates to power transmission means and has reference more particularly to means for coupling a driving and a driven member An object is to provide a clutch which is characterized by spreading fingers adapted to double the pressure on the friction surfaces

TRANSMISSION LOCK—J McDONALD Address McDonald & Cameron care of Trinity Motor Co, 1915 Commerce St, Dallas, Texas The invention has particular reference to a mechanism for locking the transmission of automobiles, motor cycles motor boats and the like It provides a lock casing attached to the transmission casing and having the gear shifting rods extending therethrough and adapted to be locked by a novel mechanism including a sliding bolt for each rod

CHANGE SPEED GEARING—R W COMPTON, Box 809, Higbee Mo This improvement relates to machine elements and has particular reference to gearing adapted for automobiles or other machinery where a change from one speed to another is desired or where varying speeds in one direction may be provided for in addition to the reverse drive

VALVE GEAR—R B SMITH, 109 Glenwood Ave, East Orange N J This invention has for an object the provision of an arrangement whereby a valve may be opened to the usual extent and held open an appreciable time Another object is to produce a valve gear or



VALVE GEAR

mechanism for multiplying the movement of *the valve shaft whereby a cam occupying a* predetermined number of degrees of a circle may open and close the valve and also provide a period when the valve is held stationary in its maximum open position

SAFETY DEVICE FOR POWER PRESSES—N SHEFF care of Mr Crain 518 W 145th St, New York N Y The purpose here is to provide a device for use on foot or power presses and similar machinery, and arranged to prevent the movable press head from descending to final position as long as the operator's hand or hands are in position between the press head and the fixed die

METHOD OF GATHERING PEAT—T RIGBY, Station Hotel Dumfries Scotland This invention is an improvement in methods of gathering peat from peat bogs and delivering it where required According to the invention, Mr Rigby proposes to cut the peat by means of any suitable excavator in the first place, to pulverize and disintegrate it in a peat cutting machine in the second place, and finally pump it in the condition of pulp along a suitable pipe to the point at which delivery is desired

DRAWING BAIT FOR WINDOW GLASS MACHINERY—I J LAQUER 1000½ 13th St Jeannette Pa The invention relates more particularly to what is known as cold bait that part of the machinery which is lowered into the molten glass and which thereafter during the blowing of the glass forms the head of the cylinder and communicates with the interior of such cylinder so as to provide for the introduction of air to the cylinder continuously during the blowing operation

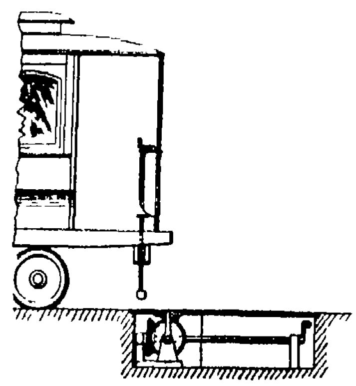
AUTOMATIC EMERGENCY, RETURN CHECK AND STOP VALVE—T B FORD, 407 Broome St New York N Y The inventor provides an automatic emergency, return check and stop valve arranged to provide a check against the return flow of the steam into the boiler from the main to isolate the main from the boiler in case of the sudden drop of the pressure in the main and to allow of manually closing the valve whenever it is desired to do so

MANUFACTURE OF BARRELS FOR SHOT GUNS AND RIFLES—F B WARNER 90 Chambers St New York N Y This inventor provides improvements whereby a highly ornamental Damascus barrel is produced and the barrel is not liable to become pitted through the action of nitric or other acids incident to the use of smokeless or nitro powders in the shells fired by the gun or rifle

GOPHER TRAP—A F RENKEN Kramer Neb In this improved trap the spear is formed with a spindle actuated by a torsion spring the spindle being disposed along a tubular body or frame and having at one end a spur to spear the gopher and at the opposite end an integral arm to be restrained by a latch adapted to engage a pivoted trigger

Railways and Their Accessories

RAILWAY SWITCH THROWER—S LEVY 60 Matlock St Paterson N J This invention relates to railway appliances and has particular reference to means for controlling the position of a switch point from the car and the term car in this case covers any type of railway rolling stock from which the movable



RAILWAY SWITCH THROWER

switch point may be operated or controlled Therefore an object is to provide an attachment for the switch point adapted to be operated by the actuation of one or the other of several plungers carried by the car and adapted to be depressed by the motorman or other operator according to the direction in which the switch point is to be moved

Pertaining to Recreation

SHOE LACING—E W LUCAS and C J SAUNDERS care of Garden City Golf Club Garden City, L I, N Y This invention relates to sport shoes such as are used by golfers and others and it has to deal more particularly with improvements in the means for lacing the shoe and in this regard the invention is not necessarily limited to sport shoes

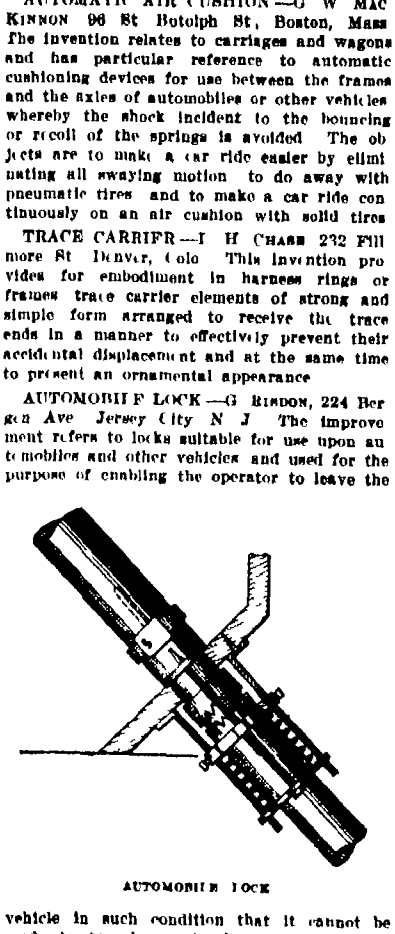
PUZZLE—J L ALLEN, Box 907, Buffalo, N Y The main object here is to provide a puzzle wherein the movable object consists of a sphere concealed by an inverted box representing any well known vehicle animal or the like and which box serves to affect the normal movement of the sphere and is itself affected thereby to defeat efforts made to deposit said movable object within a suitable repository provided therefor

Pertaining to Vehicles

AUTOMATIC AIR CUSHION—G W MACKINNON 96 St Botolph St, Boston, Mass The invention relates to carriages and wagons and has particular reference to automatic cushioning devices for use between the frames and the axles of automobiles or other vehicles whereby the shock incident to the bouncing or recoil of the springs is avoided The objects are to make a car ride easier by eliminating all swaying motion to do away with pneumatic tires and to make a car ride continuously on an air cushion with solid tires

TRACE CARRIER—I H CHASE 232 Fillmore St Denver, Colo This invention provides for embodiment in harness rings or frames trace carrier elements of strong and simple form arranged to receive the trace ends in a manner to effectively prevent their accidental displacement and at the same time to present an ornamental appearance

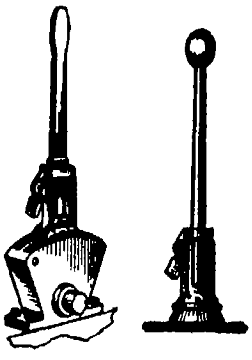
AUTOMOBILE LOCK—G RINDON, 224 Bergen Ave Jersey City N J The improvement refers to locks suitable for use upon automobiles and other vehicles and used for the purpose of enabling the operator to leave the



AUTOMOBILE LOCK

vehicle in such condition that it cannot be made to travel except when unlocked The invention provides a locking mechanism to be used in connection with the steering post in order to prevent the latter from being turned

LEVER LOCK FOR AUTOMOBILES—W J MILES, 1221 Foster Bld'g, Denver, Colo The invention relates to improvements in means for locking levers against movement when set in a predetermined position. The invention is intended for use in locking the gear shift lever of an automobile in neutral posi-



LEVER LOCK FOR AUTOMOBILES

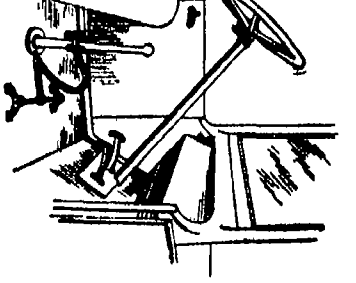
tion in order to prevent the movement of the machine by its own power when the lever is so locked In other words the object is to lock the gear shift lever against movement by an unauthorized person or one not holding a key to the padlock, which is employed in securing the parts of the device in the locking position

ROLLER BEARING—N G KIMBERLEY, Tottenham Address J D Sprundt, 8 East India Ave London, E C, England This invention relates to roller bearings of the kind comprising two sets of hollow tapered rollers which run within an outer casing or the like on correspondingly tapered outer and inner paths associated with an axle or the like one of which inner roller paths may be adjusted relatively thereto, the rollers of each set being mounted on pins the ends of which engage rings constituting a cage or frame for the rollers

SHOCK ABSORBER—B J DRYER 15 Broad St New York, N Y The invention relates to a shock absorber or cushioning device of the compressed air type and is adapted to be used in a supplementary capacity to the usual suspension springs of vehicles by being interposed between and connected with such springs and the vehicle body so as to cushion both the downward and rebound movements of the body Mr Dryer has also invented another shock absorber for vehicles and it deals more particularly with the combined hydraulic and pneumatic shock absorbing devices and is adapted to be interposed between the vehicle body and its supporting springs

TIRE PUMP—W G WILKES 505 Seal Ave Biloxi Miss. One of the main objects here is to provide means which may be automatically actuated by the normal operation of a wheel of the vehicle and a further object is to provide means for throwing the pumping means into or out of operation at will during the movement of the vehicle

AUTOMOBILE LOCK—W J MILES 1221 Foster Bld g, Denver Colo This invention is an improvement in automobile locks and has for its object the provision of a mechanism capable of attachment to existing motor ve



AUTOMOBILE LOCK

hicles without change for holding the gear shift lever of the vehicle in neutral position—that is in that position where none of the gears are in mesh during the absence of the owner from the car or whenever else desired.

DUMPING MACHINE—E. L. GARY Anamoose N D An object here is to provide a machine adapted to be driven ahead of and to dump its load ahead of the source of propulsion, means being provided whereby the machine can be drawn after the source of propulsion subsequently to dumping of the machine

BABY CARRIAGE—G DICK, R. F D No 2, Muncie Ind. This invention provides a carriage which may be quickly and easily transformed from a four wheel carriage to a two-wheel or sulky carriage, the carriage being designed to travel on the two wheels except when going over a curbing or the like when the carriage may be quickly converted into a four-wheel vehicle to provide for an easy passage of the curbing

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NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each Please state the name of the patentee, title of the invention, and date of this paper

NEW BOOKS, ETC.

MODERN CHEMISTRY AND ITS WONDERS. By Geoffrey Martin, D Sc., Ph. D. New York D Van Nostrand Company, 1915. 8vo ; 351 pp.; illustrated. Price, $2.

This is a companion volume to the author's 'Triumphs and Wonders of Modern Chemistry,' and treats of certain important and fascinating things which were omitted from the earlier work for lack of space. It aims at interesting the cultured general reader in some of the more marvelous conquests of scientific chemistry, and narrates the "romance" of such things as explosives, sugar, alcohol, coal tar, and common salt The mystery of the periodic law is set before the reader, and the light thrown upon this law by recent advances in the study of radio-active elements is clearly shown The practical applications of chemistry to industry, particularly in their more sensational aspects, are described in the text and embodied in the numerous illustrations.

INDIVIDUALITY IN ORGANISMS. By Charles Manning Child. Chicago The University of Chicago Press, 1915 12mo , 213 pp , illustrated. Price, $1 25 net

Is the unity of a living organism strictly comparable to that of a complex machine, or does this unity itself determine construct and harmonize its own elements and modes of action? The author of Individuality in Organisms" absorbingly discusses the question of what constitutes an organism and an individuality , his experiments and deductions indicate an entirely mechanistic conception, yet one which differs in many respects from the usual anti vitalistic theory Such involved conditions and ramified investigations cannot be briefly summarized It can only be said that the author presents and brings into correlation many diverse elements, and in comparatively simple language, supporting his views so ably that his work is worthy of the closest study

TRANSACTIONS OF THE AMERICAN CERAMIC SOCIETY Volume XVII Arthur S Watts Editor Edward Orton, Jr, Secretary, Columbus, Ohio 8vo , 815 pp , illustrated

The first fifty pages of the Report disposes of the membership list the financial statement, and the *rules of the Society* The main division of the volume is given over to the papers read at the Detroit meeting held in February of last year together with the discussions these papers called forth. The presidential address dealt with Our Industry and the Foreign Trade sixty eight other speakers are reported in full their subjects ranging among all the varied and intricate problems of clays and their working Many of the papers are illustrated and many carry charts of fire clay tests weight losses, temperature curves, and viscosity

THE PROBLEMS OF THE COMING PEACE. By Felix Mlynarski, Ph D, Delegate of the Polish Supreme National Committee to America New York Polish Book Importing Co, 1916 8vo, 172 pp

Dr Mlynarski is a writer of authority on sociological subjects his arguments in the present little work stress underlying conditions and causes that are not usually considered or at least that are generally slighted He, perhaps, goes to an opposite extreme in this emphasis but in the determination of what shall constitute peace with justice—the particular problem with which the author is concerned—his attitude must command attention, and the breadth and depth of his survey of history and his forecast of probabilities must be conceded

AN INTRODUCTION TO APPLIED MECHANICS By Ewart S Andrews, B Sc (Lond) New York G P Putnam's Sons, 1915 8vo , 316 pp., illustrated

Applied mechanics as the author states, is a difficult subject to teach and most students will agree that it is not a subject easy to master The author places the blame for this condition of affairs squarely upon the text book, condemning the old style text as "a kind of exercise ground for algebraic manipulation, and charging the more modern works with falling into the opposite error of presenting too much engineering application of the principles of mechanics without sufficiently explaining these principles His text leans toward graphical conceptions, and should prove acceptable in the junior class work of the engineering college or to any institution offering a comparable course.

COLOR AND ITS APPLICATIONS. By M Luckiesh, Nela Research Laboratory New York D Van Nostrand Company 1915 8vo , 357 pp , 129 illustrations 4 *color plates.* Price, $3.

Without any claim to exhaustiveness, this work includes many phases of its interesting subject. The treatment is condensed, but generally adequate and presents laws and theories, mixture methods and terminology analysis photometry and photography, and the effect of environment on color It touches also upon color effects for the stage, in the art of painting and in what we have come to know as 'color music" Altogether, a wide field of related facts and suggestions lies between the covers of the volume and makes it a work of strong appeal to all who are in any way interested in this subject, or in one of its many applications, artistic, industrial, or scientific.

Industrial Preparedness for Peace

(Concluded from page 196)

50 miles of New York has renewed the activity of its Board of Trade, but, as the president of the organization writes, "It is difficult to make the citizens see the point."

One public spirited citizen says it is of no use to attempt to get his fellow citizens interested in preparedness for industrial prosperity. Like Micawber, they are waiting for "something to turn up." Something will turn up undoubtedly! I would be ashamed to quote from some of the letters I have received from presidents and other officials of boards of trade and chambers of commerce. The officials are not to blame. It is that deadly indifference to progress, method, and scientific staff preparation which has sent only too many "old and established" business houses to the junk pile. Have you ever walked into one of those offices, where the boss has been running the business for "forty odd years" and brags about the antique policies which, in reality, are undermining its stability? Whenever I go into one of the tombs of business, where the mummied forms of past glories are laid out in conspicuous array, I am reminded of the words of the poet:

"Standing like Druids of old, with voices sad and pathetic
Stand like harpers hoar, with beards that rest on their bosoms."

One of the greatest business failures of the last century was primarily caused by the mummification of policy, and the habit of resting upon the glories of a great name. If a man had known just when and how to save this great institution from that dismal failure, and had offered assistance to the heads of that corporation, he would have been looked upon with a benign and fatherly attitude and in tones of eternal authority advised:

"Sir, we have been in this business for 66 years, we have made many millions of dollars. Our name stands the highest in banks and commercial circles. How can you, sir, hope to advise us?"

The indifference of business men to great commercial and national crises is the result of the habit of building a shell about themselves, like a clam or an oyster. It is, at first constructed for protective purposes, but becomes at last, a barrier against the friendly influences of coöperative and intelligent help. My friend Sam Murray tells a story of Jim Noonan, a half witted fellow, who was sent out into the woods to bring in the sap-kettle. Jim hitches up the team of mules to a stone-bolt and drives out into the woods. It is a very cold day, the wind is strong and biting. Jim manages to get the heavy iron kettle upon the stone bolt, and walking back of the load, drives the mules toward home. In order to get out of the cold blasts of the wind, Jim conceives the idea of riding in the kettle. He climbs into it, and makes him self cozy and comfortable. Now there happened to be a culvert in the road, which rose in the form of a ledge for about 9 inches above the level of the roadway. Jim had forgotten it in the pleasure of his security from the wind. When the blunt nose of the stone-bolt struck the culvert, something happened. It all happened so quickly that poor Jim imagined for a moment that he had passed into the land of eternal night. The "inverted' bowl of Omar had suddenly pressed itself down upon him. He was in a cell much more secure and oppressive than that of the Prisoner of Chillon. The mules returned home with the stone-bolt, but Jim and his kettle were missing. The hours passed. When darkness fell it was thought best to send out a searching party. By the flickering light of many lanterns, they finally came upon a strange and marvelous phenomenon. The kettle was slowly making its way, inch by inch, in little jerky moves, toward home. Poor Jim! For the sake of getting in out of the wind, getting away from the cold and biting blasts of winter, he had taken shelter in the spacious depths of the kettle. So long as he could ride in the kettle, right side up, it was a splendid thing, but when reversed, and he had to bear the burden of its ponderous weight upon his shoulders, he had to work his way, inch by inch, in the darkness of his dome-like cell.

I can never forget Sam Murray's story about the syrup kettle. I have found so many, many business men laboring along over the roads of business, hidden in the shell of their own making.

The boards of trade and the chambers of commerce of the cities and towns of the country can perform a great service to the business interests of the various communities. The officials of these organizations, however, must have real assistance, real coöperation, from every business man in the community.

It is the duty of such officials to lift the kettle off the backs of all those poor devils who are trying to get home—out of the wind.

"Treasure Island's" Realistic Ship

(Concluded from page 201)

reality the "Isle of Pines" south of Cuba and the crew has mutinied in good old pirate fashion. Then comes the fight at the stockade and finally the "Hispaniola" gets adrift in the next scene and the audience is treated to the sight of Black Dog and Israel Hands—unhung pirates of the deepest dye—and they look the part—fight to a finish while Jim Hawkins in the rigging is tossed about as he saves him self from Israel Hands with his pistol. The rest of the story, brimful of charts, mystery and "pieces of eight," need not detain us for our interest lies with the good ship "Hispaniola."

A vessel on the stage is usually a ridiculous example of the stage carpenter's art. It comes alongside and makes a few breezy attempts at rising and falling and all is still, but not so in "Treasure Island," where we have an animated boat 32 feet long which trembles and pitches and rolls and creaks worse than a 26-knot Channel steamer before the war. The ship was designed by Mr. George Vivian and built by Mr. Henry L. Gebhart, and shows much clever designing, especially since it can be dismantled for transportation purposes.

The ship is brought in mounted on a truck *C* running on casters. On this truck is a horizontal cradle *A* with curved ends adapted to give the boat a fore and aft pitching effect by means of the levers *D* and the rocker shaft *G*. The play is limited by chains and springs. On this cradle rest, at right angles, three more athwart ship cradles *B*, which support the ship. These cradles serve to give the ship a rolling effect through the levers *E F*. While normally four men can give realism by actuating the boat, in practice it is found that a few stage hands can apply strength to advantage in simulating the effect of the choppy seas of the Caribbean. The scene from the front of the stage is excellent, the mechanism and operatives being masked by sea green cloths. An electric fan helps the flag to flap merrily and the curtain goes down to delighted applause from those in the bijou playhouse.

Motor Truck Queries

(Concluded from page 202)

a small hole should be drilled at each end of the crack to prevent it spreading any further. The neatest method in volves drilling and tapping a series of holes and screwing in finely threaded brass rods. A hole is drilled and tapped and the rod screwed in and cut off flush with the surface of the water jacket. A neighboring hole is drilled so that a portion of the plug just screwed in is cut away, this is tapped and another piece of rod screwed in and cut off. This operation is continued until the crack is completely filled with the brass plugs. These are filed flush and a layer of solder sweated over the surfaces. If the cleaning is carefully done the solder will adhere to the cast iron of the jacket as well as to the brass plug. Another method is to use a piece of brass plate about an inch and one half wide and an inch longer than the crack. This is fastened to the water-jacket wall by means of a series of small machine screws which

fit into tapped holes drilled in the water jacket. Before permanently securing the patch a piece of sheet rubber packing is cut to conform to the patch and punched with holes to match those in the plate. The screws are coated with red lead, as is the under surface of the rubber packing, and the plate is securely applied to the cylinder casting to hold the packing in place between it and the water jacket If this repair is carefully carried out it is not only neat but inexpensive

J F W writes We are engaged in the lumber business and have recently purchased a three-ton truck fitted with a stake platform body We would appreciate any suggestion you could offer for fitting up this body, particularly with our requirements in view, to facilitate loading and unloading the lumber

Answer A very economical way of loading lumber, and one that also permits the truck to be kept busy, is to make a series of cradles that will fit your truck platform and to load these cradles when they are on the ground In this way the cradles can be loaded while the truck is making deliveries, and are lifted in place on the platform when the truck is ready to receive them Unloading will be considerably facilitated by providing a series of rollers along the truck platform This is illustrated on page 202 These may be turned by suitable gearing actuated by a hand crank, and if a pair of the rollers are interconnected by means of a driving chain the load will be easily shifted by turning the rolls These rollers also facilitate handling the loaded cradles as they may be lifted by any suitable means and rolled in place on the truck platform

A New Wood Pulp Process

THE chief element of cost in the production of the paper on which our daily newspapers are printed is chemically prepared pulp of wood though this constitutes only about 15 per cent of it the remainder consisting of the entire substance of the tree, excepting bark, branches and knots A small proportion of clay and sizing is added to give the fabric a surface and make it take the ink well The chemical pulp referred to is cellulose in a more or less pure condition made by boiling wood under pressure in a solution of bisulphite of calcium, from which it gets the name sulphite pulp

The discovery of any process for lowering the expense of production of even the cheapest of papers will in these days of advancing prices for all commodities invite the interested attention of paper manufacturers, who are faced with the problem of overcoming high production costs caused by the growing scarcity of raw materials and the general advance in price of labor as well as supplies The tendency is to cut down the amount of chemical pulp employed and increase the proportion of the ground raw wood

Under ordinary conditions, where ground wood alone is used as the body of news print paper, trouble is experienced in the formation of the sheet on the paper machine. The rosin which remains adherent to the wood when it is reduced to pulp by the action of a grindstone, clogs the wire meshes of the paper machine and reduces the speed of manufacture, it also causes trouble by making the paper stick to the presses. Then the fibers which are disintegrated by mechanical pressure are never of full length but are invariably short and lacking in the quality of toughness that is characteristic of fibers produced by boiling the wood in solutions of bisulphite of lime, caustic soda or sulphate of soda, to form chemical pulp, or sulphite.

Various attempts have been made to improve the grinding process so as to overcome the destructive cutting action of the stone on the wood fibers and impart pliability and smoothness to the resulting pulp. The endeavor has been made to incorporate mineral loading material, like china clay or talc, by feeding it with the sprinkling water at the point of contact with the grindstone, and the pulp wood, the idea being to soften the friction of the stone and obtain a crushing rather than a cutting and disintegrating action but with no pronounced success.

The most promising invention having to do with the manufacture of a ground wood pulp, which can be used alone or with a greatly diminished proportion of chemical pulp for the production of printing paper provides for a preliminary treatment of the pulp wood with hot water under pressure in a closed receptacle This is the subject of German patent No 288 630 class 55a granted to Leopold Enge of Niederschreiberhau, in the Riesengebirge. In this process, by a manipulation of pressures and temperatures and without the use of chemicals the inventor obtains a ground wood pulp as white as the ordinary ground wood pulp made by the standard process which possesses the tough characteristics of sulphite pulp and is, indeed, deemed capable of replacing sulphite pulp in the manufacture of newsprint paper

The element of novelty in the process invented by Enge consists of the treatment of the pulp wood before grinding with hot water under pressure the hydraulic pressure being maintained at a higher degree than the steam pressure and equivalent to the temperature of the water For many years boiled wood has been employed in England in the manufacture of a coarse wrapping paper known as Nature brown the pulp obtained by cooking wood under ordinary conditions at temperatures above 212 deg Fahr being greatly discolored Discoloration of pulp by the new process is negligible, and the quality of the product is said to be vastly improved

According to the patent specifications it is immaterial in the Enge process whether the contents of the wood boiler are first raised to the treatment temperature and then put under pressure or whether pressure is applied initially and the contents subsequently raised to the treatment temperature The period of treatment is said to be shortened when the pressure is applied after the heat in the boiler registers 212 deg Fahr At this temperature the equivalent steam pressure in the boiler completely filled with wood and water is 20 lb per square inch As soon as the boiling point of water is reached the supply of superheated steam is shut off and hot water is pumped in until a pressure of 147 to 191 lb is registered, thereby preventing any further boiling of the water It is of importance that the contents of the boiler be not subjected to a heat in excess of the equivalent steam pressure In other words the pressure must be increased as the temperature rises since if the pressure falls the water boils and discoloration of the wood will ensue With an average temperature of 230 deg Fahr at 147 to 176 pounds per square inch pressure maintained for six hours a light colored strong pulp can be ground that is said to be admirably adapted for news and book papers The final treatment in the boilers before the wood is ready for grinding consists of the application of direct steam for a period of two hours at a temperature no higher than 230 deg Fahr

The wood as it comes from the boiler after this parboiling process will be found to be three times as heavy as wood cooked by the older steaming system already referred to as it is heavily saturated with water, having been cooked to the core The grinding of the wood is effected with stones of the same grain as that used for ordinary white mechanical pulp As the fibers are more swollen and softer than those of ordinary ground wood the perforations in the centrifugal apparatus for the extraction of surplus water are enlarged to 048 inch The pulp must be beaten smooth and smeary rather than coarse and short.

The new process has excited the liveliest interest among paper manufacturers both in this country and in Europe, the periodicals of the pulp and paper industry are publishing articles descriptive of the process and product, and eminent experts in paper technology have considered the subject one worth devoting their time to investigating.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14048) J J C asks I am writing to ask whether or not there have been any practical applications of inventions of electric motors which use a non magnetic metal If you know of any applications, about what has been the efficiency in respect to other motors, that is standard motors? I have witnessed the demonstration of an electric motor which uses an aluminum disk outside of the coil in place of an armature of the regular type It has a very high speed and delivers a lot of power to pulley wheel The inventor claims an efficiency equal to the standard motor for the amount of current consumed. The coil is circular, in form of a large doughnut The soft iron core is wrapped at a number of separated intervals with insulated copper wire This coil is held stationary from its center by an expanding foot fastened to a base support The armature is replaced by two aluminum disks which fit face to face like inverted saucers partially surrounding the coil These disks are keyed to shaft which passes through their center as well as through the center of the coil in such a position that they can revolve about the coil The present application uses an a c current three phase For the weight of the material in the motor it delivers more power than any standard motor I have tested I was not equipped for meter tests Its strong points are cheapness of manufacture and low upkeep cost and inability of being burned out by over load or shorting I have personally held the motor while full load current was passed into it After a little the aluminum disks will warm up and probably if held long enough would get hot Any information in regard to non magnetic metals being used in motors I will be much obliged for I append a rough sketch in order to better explain the appearance of the motor A The motor which you describe is an alternating current motor with a rotary field Such a field generates by induction currents in the disk which causes it to rotate with the rotation of the field A number of rather spectacular experiments have been developed from this phenomenon. It looks strange to see a metal disk rotating rapidly with no visible driving force The motor will not run with a direct current The disk heats because much of the current generated in it is converted into heat. The disk may be of any metal Magnetism has no connection with the rotation The motion is produced by the action of the rotary field, causing electric currents in the disk. Motors made upon this principle do not have simple disks of metal, but have some form of coils which is equivalent to an armature although it is called a rotor since it turns The action is that of a transformer, the field, or stator, as it is called, is the primary and the secondary is the arrangement of conductors which carry this induced current. In some forms the name "squirrel cage is given to it, from its resemblance to the rotating drum of a squirrel cage

(14049) F K. J asks How many types of detectors are there in common use and what does each, briefly consist of? A The most common detectors are the crystal, electrolytic magnetic and valve types. The former consists of a suitable crystal possessing certain rectifying properties, on which rests a fine point of wire. There are also other variations of the crystal detector in which two crystals are employed in contact with each other The crystals employed in these detectors have the power of allowing all impulses of a certain polarity to pass through them, while other impulses are barred causing them to seek another path which is offered by the telephone receivers connected in the circuit The electrolytic detector, although in common use several years ago, has been practically abandoned In sensitivity, however, it ranges very high, but the simplicity and cleanliness of the crystal detectors caused their adoption in preference to the former The electrolytic detector consists of a suitable container for a weak acid solution—usually a 20 per cent solution of nitric or sulphuric acid—to which contact is made in some suitable manner, while into the liquid or electrolyte dips a fine, hair like piece of platinum wire, connected to the other side of the circuit. A battery and a pair of telephone receivers are employed in connection with the electrolytic detector The potential is adjusted by means of a potentiometer—a form of rheostat or adjustable resistance—until the bubbles of gas formed at the point of the wire practically insulate the point and prevent the further flow of battery current which is then on the verge of breaking down the thin film of insulating gas surrounding the point. According to the generally accepted theory, the feeble, high frequency current of the received waves, flowing to the point of the platinum wire, is of sufficient power to penetrate through the gas film.

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which, as already stated, has just been able to hold back the battery current The momentary breaking down of the insulation allows battery current to also pass, which causes the signals to be heard in *the telephone* receivers. However, the instant the high frequency current stops the battery current causes the gas to again form and insulate the point It will be appreciated that the action of this detector is entirely automatic The magnetic detector consists of two windings one placed over the other, connected respectively to a pair of telephone receivers and to the aerial and ground connections through the tuning apparatus Through the common center of both coils passes a continuous and moving band of soft iron wires driven by a clockwork motor Two horse-shoe magnets are placed near the two windings and the iron wire band As to the operation of the magnetic detector it is best expressed by J A Fleming in his work "The Principles of Electric Wave Telegraphy as follows

When the band is driven forward the portion of the band nearly opposite to the magnet poles becomes magnetized but, owing to magnetic retentivity or hysteresis, that portion in virtue of the motion of the band is shifted forward in the direction of rotation and is not therefore suited symmetrically with respect to the poles If an electric oscillation *passes through the oscillation coil* it annuls the hysteresis of the iron and this magnetized portion slips back suddenly into a position exactly opposite to the magnetic poles This amounts to moving a magnetic pole through the coil connected with the telephone and it creates an induced current in this latter coil and hence a sound in the telephone The extreme sensitiveness of the telephone to induced currents bestows upon the whole apparatus a very great power of detecting feeble electrical oscillations When used to detect electric waves the oscillation coil is connected in between two aerial wires or between one aerial wire and the earth Lastly the valve type of detector is perhaps of greatest interest because it is fast replacing all other forms of detectors Briefly the gas valve—taking the Audion as an example since that form is the most generally used —consists of a miniature electric lamp with a filament of tantalum or tungsten a small plate of nickel arranged parallel to the filament and a grid shaped wire interposed between the filament and the nickel plate In the standard form of Audion there are two filaments one filament is used until it becomes exhausted and the *other is then pressed into service* resulting in the doubling of the life of the lamp The filament is supplied with current from a storage battery usually of a potential of about five volts A rheostat is inserted in the filament circuit so that the current can be accurately regulated for the sensitivity of the detector depends to a great extent on maintaining the filament at a critical temperature Another battery is also required in the operation of the Audion this battery being composed of a large number of cells furnishing current of a potential variable from 15 to 40 volts The positive or + lead from the high tension battery is connected through a pair of high resistance telephone receivers to the nickel plate in the Audion bulb the negative or — lead on the other hand leading to one side of the filament. The other side of the filament is connected to the tuning apparatus The grid is also connected to the tuning apparatus The Audion is not that of a simple rectifier or valve but rather that of a true relay device The high frequency oscillatory current of the incoming signals appears to bridge the Audion detector as long as it flows through it enabling the high tension current of the *telephone* circuit to flow across the gap and cause audible signals to be heard in the telephone receivers.

(14060) P M C asks I am in the compressed oxygen business and often a question comes up that cannot be settled without a reliable formula for instance a short time ago I had the occasion to find the weight per cubic foot of oxygen at 72 degrees F I was unsuccessful and have not located one Can you direct me to a text book that would give formulas for determining this weight and for all formulas concerning compressed gases high pressure cylinders, etc ? A The weight of a cubic foot of a gas at any temperature is found from its weight at the freezing point and its expansion by heating If the pressure remains the same and the expansion is due wholly to the change of temperature, the weight will be inversely as the volume Thus if a cubic foot should expand to 2 cubic feet at the same pressure the weight of a cubic foot would be reduced to one half its former value For moderate changes of temperature all gases expand very nearly the same This expansion for each degree Fahr is 1/459 of the volume at the *freezing point* If a gas is heated to 72° Fahr it will expand 40/450 of its volume at 32 F There will remain in the original cubic foot of space 410/450 of the gas and it will weigh 410/450 of its former weight One cubic foot of oxygen weighs 0 0892 lbs Avoir and 410/450 of 0 0892 lbs. will be the weight of a cubic foot of oxygen at normal pressure and 72 Fahr You will find the weights of a cubic foot of most gases on page 176 of Kent's Mechanical Engineer's Pocket Book, which we send for $5 00 post paid. For a compressed gas, you can find the weight per cubic foot at atmospheric pressure or approximately 15 lbs per sq in from the table For each 15 lbs. gauge pressure the weight of gas increases proportionately At

15 lbs. on the gauge one volume has been pumped into the cylinder, at 30 lbs. two volumes, etc., and the weight increases accordingly. This is true only if the gas is allowed to cool to the original temperature after it has been heated by the pump in compressing it.

(14051) O L. M asks I desire that you give me correct information as to the shortest day of the year and the longest. Also what are the correct dates that the sun crosses the equator line. A The phrase "shortest day" and "longest day" have two senses. They may refer to the time from sunrise to sunset, and they may refer to the time from midnight to midnight, or noon to noon. If your inquiry is for the shortest time from sunrise to sunset the shortest day is the day of the winter solstice, which in 1915 was December 22nd and in 1916 will be December 21st. The fact that February has 29 days this year moves the date of the winter solstice back. The longest time from sunrise to sunset is that of the summer solstice. In 1915 this was June 22nd and in 1916 it will occur on June 21st. If the longest time from midnight to midnight is intended by the inquiry, that day is January 2nd in 1916 the day when the earth is nearest the sun and is revolving swiftest around it. The shortest day in 1916 is July 3rd, when the earth is farthest from the sun and is moving slowest. The sun crossed the equator last September on the 23rd. It will cross the equator March 20th in the morning and again on September 23rd when autumn begins. These events vary in the month and do not occur on the same day of the month. It is however commonly stated that the equinoxes occur on the 21st of March and September. This statement is not accurate.

(14052) W F V asks 1 How many cubic feet of hydrogen and oxygen gas can be obtained from one cubic foot of water by the electrolytic method also what amperage and voltage is required to produce this amount of hydrogen and oxygen in a given length of time? 2 Is there any chemical that can be mixed with the water that will hasten decomposition, or aid the electric current to tear apart the elements that compose water? 3 What is the largest amount of hydrogen and oxygen that can be produced in a given length of time by any method now known? 4 Is there any books that deal with this subject exclusively and where can they be had? A 1 One cubic foot of water contains about 1 230 cu ft of hydrogen gas and half as many cu ft of oxygen gas. For the commercial production of these gases by the electrolytic method an e m f of about 3 volts is employed. To separate a cubic foot of water into oxygen and hydrogen about 244 kilowatt hours are required. 2 If iron electrodes are used the water should have about 15 per cent of sodic hydrate dissolved in it. If lead electrodes are used sulphuric acid is added to the water. These substances are not used up in the process but serve to render the water a conductor of the electric current. Pure water only is added from time to time as it is decomposed into its gases. 3 The quantity of gases produced in a given time is limited by the size of the apparatus. If you wish a large quantity you must have a large outfit. 4 We can furnish you with Engelhardt's Electrolysis of Water, translated by Richards, for $1 25

(14053) F P C asks Can you give me a formula for preparing a glue or cement for use on paper that is transparent to a certain extent, that will be insoluble in cold or hot water and that will not stain the paper to which applied? A. Our Cyclopedia of Receipts, which we send for five dollars, postage paid, contains a large number of receipts for waterproof glues, which are insoluble in hot or cold water. They generally are made with a chromate and become insoluble by the action of light upon the glue after its preparation. You will find these receipts upon pages 311, 312 and 385.

(14054) C E E. asks If a body of water at a temperature of 40° were absolutely confined in an unbreakable vessel, and the temperature lowered indefinitely, would the pressure caused by the crowding of the molecules lower the freezing point sufficiently to keep the liquid from crystallizing? A Water cannot freeze unless it can expand, and if ice is compressed to the volume which the water had before it froze it will turn back to water. Ice can be melted by pressure only at a temperature lower than 32 degrees Fahr. The experiment has been performed many times. This is expressed in the books by saying that the freezing point of water is lowered by pressure. This is true of very few materials. Most substances have their freezing points raised by pressure and melting is prevented by pressure.

(14055) W B. C. asks Kindly advise me if there is any difference in the thermal conductivity between cast iron and wrought iron; in other words, will one transmit more B.t.u. than the other? Is the thermal conductivity of a substance dependent on its thickness entirely? All this in connection with a hot air furnace. A The conductivity for heat is about one quarter greater in wrought iron than it is for cast iron at the same temperature. The thermal conductivity of the same material in different thicknesses would vary with the thickness. That is, if a definite difference of temperature were maintained on the opposite sides of a plate of metal, the amount of heat which would pass through the plate per minute would vary as the thickness of the plate.

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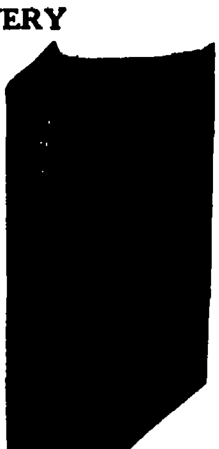

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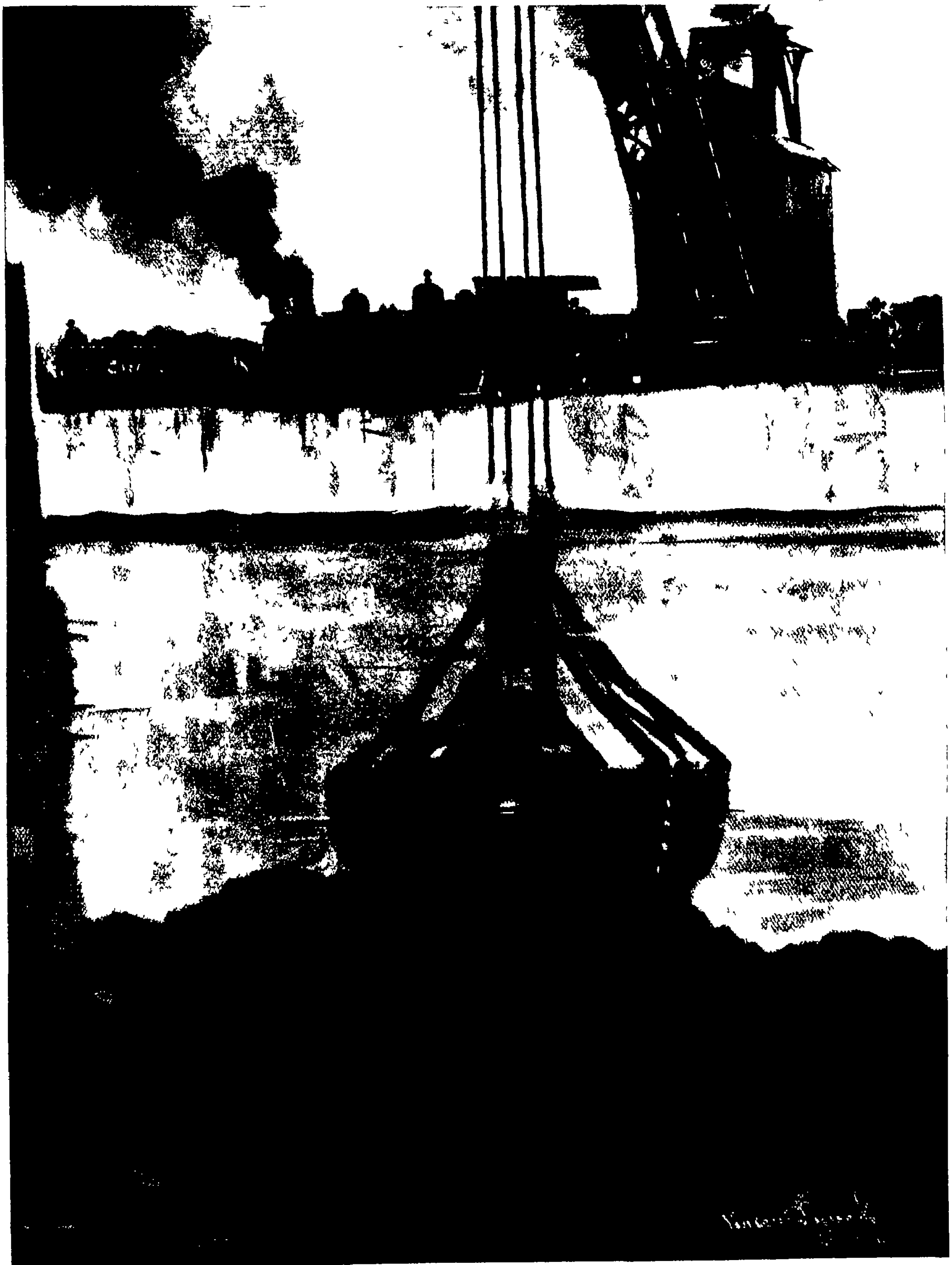

USING AN ABANDONED QUARRY FOR THE STORAGE OF COAL [See Page 222]

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SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

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Typical small town landing and warehouse on the Mississippi. These will soon be replaced by modern structures

Primitive harbor at Baton Rouge, La. Fast steel barges cannot operate at a profit under these conditions

Coming Restoration of the Mississippi as an Important Artery of Commerce

By O R. Geyer

CAN the Mississippi river once more become an important highway of commerce?

Experienced river men who have been watching signs of the coming restoration of inland navigation on the river believe that it can and that the day is not far distant when the Father of Waters will be restored to the proud position it once held as the nation's greatest artery of commerce After 30 years of inaction and failure to grasp the possibilities in the situation steps have been taken to revive navigation on a large and dependable scale and in the Spring the first of the 36 fast steel barges now being built will begin plying between New Orleans and Minneapolis

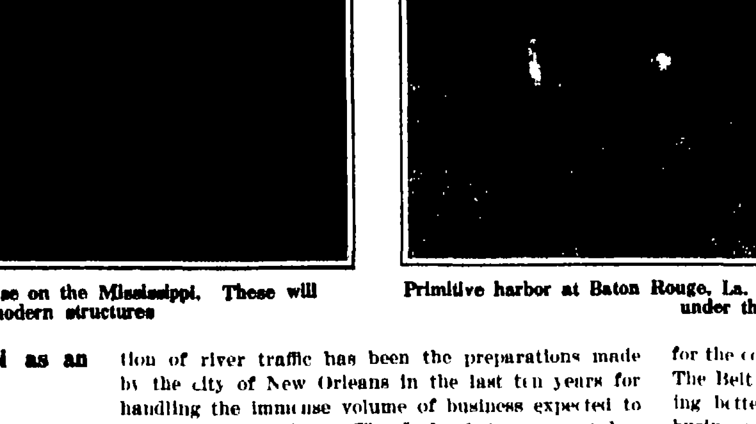
Some of the more progressive terminal points along the river have set about finding river navigation where they lost it—failure to provide modern cheap terminals to compete with the railroads New Orleans is the leader in this movement and is spending nearly $100,000,000 in preparing the port for the expected revival of navigation. To-day the snagged, shoal marked river exists only in the pages of Mark Twain's stories or in the memory of the few remaining pilots and river men of the turbulent days on the river, and now it is as easy for the captain to steer his course down the 2,000 miles of waterway as it is to make his way down the main street of his home town

The primitive river front wharfage facilities and the lack of modern coördinated terminals have done more than anything else to postpone the new era in navigation on the Mississippi Since the railroads came with better and cheaper terminal facilities many years ago, there has been no really determined effort to take advantage of the vast opportunities awaiting those making proper use of the river way Minneapolis Davenport, St. Louis, Quincy, New Orleans and a few of the larger ports have taken definite steps to recapture the river trade thus lost When these modern terminals are completed they will find that the Government has more than kept pace with their efforts in bringing about the realization of the long-dreamed-of six foot channel

Nearly $60,000,000 has been spent or will be expended in building one of the greatest ports in the world at New Orleans. Davenport, Iowa, is spending about $1,000,000 in building a sea wall and installing modern terminal facilities, and Minneapolis is spending about $300,000 in building a river terminal A Government dam will give that city an average of 8 feet of water off the new wall, so that some time this year Minneapolis actually will become the head of navigation on the river. St. Louis is building the first unit of a modern coördinated river-rail terminal, and Muscatine, Iowa, has appropriated a large sum for the first unit of a concrete terminal.

One of the marvels of the long fight for the restoration of river traffic has been the preparations made by the city of New Orleans in the last ten years for handling the immense volume of business expected to come down the river The Federal Government has spent $18,000,000 in building a deep sea channel to the Gulf of Mexico a distance of 120 miles and more than $2 000 000 in bank revetment and harbor improvements or a *total of about* $20 008 000 The *greatest* steamships in the world may steam up the river a distance of 260 miles or more than 40 miles above Baton Rouge and great oil tankers and freighters from all parts of the world do an immense business on the lower river

The greatest share of the expense of improving the river and port has been borne by New Orleans and the state of Mississippi, the latter through a number of bond issues. The city has spent $4 405,000 in building a modern system of docks, sheds and wharves and now is building a mammoth cotton warehouse, the first unit of which has been completed There will be storage room of 100 acres, and 2,000,000 bales may be



A typical shipping scene in New Orleans At the head of the Canal street steamboat landing

handled annually This improvement will cost $4 000 000 and will contain every modern electrical device to cheapen the cost of handling the cotton Traveling cranes will carry four bales of cotton at a time and will store them in the all-concrete-and steel warehouse and, if desired, will pull out the bottom bales without disturbing the others The dock warehouses will have facilities for handling 75,000 bales under roof for loading on ocean steamers The bale-piling machine to be installed will save 11 cents on each bale handled

New Orleans also expects to spend $3,000 000 in building immense warehouses to care for the traffic in coffee lumber grain and general merchandise Switching charges have been reduced from $12 to $2 a car by the municipal belt line railroad and free terminal facilities will be given river boats, according to present plans. A channel connecting Lake Pontchartrain and the river will be built by the city at a cost of $2,500,000 to provide waterway frontage for many private firms This is not the entire sum the dock board will have at its disposal, for there still remains a bond issue of $25,000,000 to be disposed of as the proceeds are needed for the continuation of the harbor improvement scheme The Belt Line railway is spending $1 500 000 in providing better facilities for the handling of the freight business which is expected to begin coming down the river this year

Within a few years time New Orleans will have spent $60 500 000 in river and harbor improvements, which will give it one of the greatest ports in the world This does not include $30 000 000 expended within the city itself to provide better sewerage and water systems The work of rat proofing the city will cost $7 500 000 so thorough are the preparations being made for the revival of inland navigation

The work that New Orleans is doing supplements that of the state of Illinois in digging an 8-foot barge canal from Chicago to Davenport The Government has co-operated even further by building the world's greatest inland drydock at Keokuk, which can care for three of the largest river boats at one time Even more important work is being done in blasting a 6-foot channel through the dangerous LeClaire rapids below the town of LeClaire Iowa on which more boats have come to grief than through any one other agency on the river The LeClaire canal will be 250 feet wide and about 3 miles long The Iowa shore will be used for one bank of the canal and a cofferdam is being built on the outer, or river side When the work of blasting and excavating the rock is completed which will take another year a dam and locks will be erected at the lower end of the canal

The LeClaire rapids are the last great obstacle in the way of a 6-foot channel Under present Federal rules ships are forbidden from trying to pass the rapids in the night time because of the great danger Five years time probably will be required before the large river boats can pass through the canal at any time during the 24 hours of the day

The port of New Orleans will be one of the wonders of the world when fully completed At the present time it consists of 41 4 miles of river frontage all under the control of the city dock board This harbor has a developed area of more than 7 square miles, while the deep water area within the port limits totals 11 square miles The harbor varies in depth from 40 to 188 feet In time should conditions warrant it steel sheds and wharfage facilities could be extended from Point a la Hache to Baton Rouge about 178 miles which would provide a deep waterway harbor of 85 square miles The public wharves have a platform area of 3 777 166 square feet and steel sheds three quarters of a mile long protect a wharf area of 2,558 906 square feet

The methods of handling freight, once it reaches the 'Valley Gateway' as New Orleans is known will be the most improved known to the world The gang plank, a representative of the present day inefficiency

(*Concluded on page 228*)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs

Secretary Daniels and the Naval Emergency

TO all patriotic Americans whose eyes are unclouded by party politics it is perfectly clear that the United States navy is confronted by one of the most serious crises in its whole history In a matter involving the violent death of over one hundred American citizens we are to-day engaged in critical negotiations, during which the relations of this country with the second greatest naval power in the world have more than once been strained almost to the breaking point. Moreover the naval power in question believes that, because of the ammunition question, it has cause for a deep-seated grievance against this country History teaches us how readily the seeds of bitterness may become the seeds of war, and hence the question of the relative strength of our own navy and that of the nation in question becomes of paramount importance

How, then, do matters stand? What is the relative strength of the United States navy and that of Germany? It is readily stated

To Germany's great fleet, *in commission* to day, of twenty two dreadnoughts we could oppose but eight, and by the summer of this year but eleven

Among those twenty two dreadnoughts are five battle-cruisers of twenty eight knots speed and against these we could oppose not a single one

Against Germany's fleet of a dozen or more up-to date, twenty-eight knot scouts we could oppose only three of a slow and obsolescent type

And against Germany's still numerous fleet of large, able, seagoing submarines, well seasoned by months of arduous war service, we could oppose a fleet of small, non-seagoing submarines, of such doubtful value that, in the opinion of our seagoing officers, they should never venture far afield from their home ports

Thanks to the efforts of patriotic societies, such as the Navy League and the National Security League, these facts have been brought home to the American people A demand has gone forth that the question of the defense of the country, both naval and military, shall be lifted up out of the realm of party politics, and debated from the patriotic standpoint of the highest good of the nation It is demanded, furthermore, that the plans of defense of the naval and military experts of the country shall be brought out of the pigeon hole and put into practical operation

So far as the navy is concerned, it is now well understood by the country at large that if the plans of the General Board had been followed our navy would to-day be of equal strength to that of Germany Owing to the indifference of Congress, the Navy Board plans have been ignored for the past ten years with the result that we are deplorably lacking in naval strength

If Secretary Daniels could have had his way, the plans of the Board would have been ignored this year, but, yielding to the public demand, Mr Daniels, who at first suppressed the General Board's report has now made it public, and it is revealed that the Board asked for a far larger increase of the navy this year than is called for by the so-called five year program of Mr Daniels

The five-year program is misleading, for it gives a false impression of immediate naval increase It will be eight years or more before all the ships proposed will have gone into commission, and because of the naval activity of other nations it will not only fail to restore our navy to second place but we shall have fallen even lower in the scale than we stand to-day

We are ten battleships behind the General Board's program and the deficit should be made good at once This can be accomplished during the next two years if the present administration will invite the co-operation of the great shipbuilding firms of the country which, if they could be assured of steady work and fair treatment stand ready to enlarge their building ways and add to their shipbuilding plants.

It is because Great Britain has encouraged her great private shipbuilding firms to take naval contracts and has treated them with reasonable business confidence and courtesy that she possesses such a magnificent navy Had it not been for her coöperation with the private yards, Great Britain would be blockaded at this hour and the Allied Cause would have lost in the great war It is no exaggeration to say that the private shipbuilding firms of Great Britain have saved the British Empire from disaster

We beg to ask what has been the attitude of the present Secretary of the Navy with reference to conditions in this country? Has he been actuated by that broad patriotic and unselfish motive which alone could secure adequate results? It has been evident from the beginning of his administration that the Secretary of the Navy was under the sinister influence of the Bryan régime, which has been in so many respects detrimental to the country

The Secretary's animosity against private yards and private shipbuilders has been manifest from the first At a time when every effort should be made to develop and upbuild our private shipbuilding yards the Secretary has been manifesting a hostility toward them and toward the shipbuilding interests of the country which is not in harmony with the desire of the people to see our fleets, naval and commercial, extended upon the high seas

The ostensible reason given for this policy on the part of the Secretary is to introduce economies and to develop the resources of the Navy Yards. There is no reason why our yards should not be maintained in a state of high efficiency, but there is every visible reason why both our private yards and the navy yards should be simultaneously encouraged in every possible way, and it is only by such encouragement and support on the part of the Government that the desired results may be obtained

The Secretary's hostility to the private firms has led to an inexcusable delay in the construction of two of our latest battleships, Nos 43 and 44, which were authorized by Congress a year ago He made it his business to find fault with the bids of the private ship yards, and made this the excuse for having them built in navy yards So one ship is to be built at the New York yard *when the ways have been vacated by the "California," now building there*, and the other ship is to be built at the Mare Island yard, San Francisco, *after a new ways has been prepared and the proper plant erected there*

And thus, in spite of the fact that the nation is crying out for the immediate increase of our navy Mr Daniels delays the construction of these ships by a good year and a half

Furthermore, although the navy yard work is excellent, it is more costly than private work. The estimates showing that it costs no more are fictitious, for the navy yard never includes in the cost the heavy overhead charges which form one of the principal items in estimating the cost of privately built warships.

President Wilson has spoken eloquently in favor of a strong navy The question naturally suggests itself whether the plans of the Administration can be adequately followed out without some radical change being made in the methods and policies which have been pursued by the Secretary of the Navy during the present Administration No satisfactory explanation has been given by the Secretary to those who are anxious to see the United States navy maintain a proper and adequate position, of the delay of nearly two years which will result from his fatuous policy

Cremation versus Burial

EMERSON, in the diary of his European trip, noted that the French have engraven on the tombstones of their dead "Here Lies——", our American custom, "Here Lies the Body of——" is more consonant with the ever impressive statement, "there is a natural body and there is a spiritual body," in the service for the dead In weighing the comparative methods of cremation and burial this beautiful Pauline sentiment should go far to remove pious prejudice to incineration Is not, after all, material life from the cradle to the grave, but a slow oxidation, a continuous process of cremation? There is still a vestige of the theological view that the material body should remain whole until the last trump, that it should not appear otherwise in the presence of its Maker But this is inconceivable of any body that has been beyond several decades in the grave. Yorick's skull becomes hopelessly intermingled with the spine of an erstwhile neighbor, the thigh bone of another, bodies autopsied by physicians are thereafter no longer whole The gruesome idea need be no further pursued On the other hand the ashes of the dead could be perpetuated so long as any memory of the life representing it would endure, while the spiritual body may be believed to remain whole perpetually Will not then the reverent, on taking thought, find the columbarium preferable to the grave?

Cremation obtained among many ancient peoples. Especially did the Greeks find spiritual grandeur in the concept of the soul arising from the ashes of the dead—the natural body—into the empyrean, to dwell thenceforth with the stars. Cremation was indeed an honor denied the bodies of suicides, those who had been struck by lightning, and others deemed to have forfeited the favor of the gods.

Should religious objection to cremation be removed, there would still have to be considered the facility it is assumed to afford murderers and other criminals for the concealment of their crimes But adequate safeguards can be, indeed are, legally established. In England no human body may be cremated until two independent medical certificates have been given. In the event of doubt ample provision is made for post-mortem examination

Thus there can remain no other reason why cremation should not be preferred to burial, while there are peculiar objections, besides those mentioned, to burial—a slow process, most repugnant to the imagination, and inspiring, as it certainly did under the asceticism of the middle ages, much occasionless horror of death, a natural biologic phenomenon. How dangerous burial is to the living, especially in large cities and where graveyards are contiguous to human habitations, all health authorities are fully aware

Cremation is indeed a method no longer on trial, it is established in many places throughout Christendom A point, however, is demonstrated in the experience of the Cremation Society of England, which was founded in 1874 in the hope of interesting the poor (who are very prone to spend far more than a right proportion of their means on funerals) this society made its fee $25—a sum several times cheaper than the cost of the burial Yet this poetic manner of disposing of the beloved dead has thus far, in England, found favor least among the poor, and chiefly among the professional, the intellectual and the well to-do.

War and the Medical Profession

PREVIOUS to the fighting now going on in Europe it cost, in modern warfare, about $15,000 to kill a man, in the Boer mix up this item came higher, $40,000, the Balkan row with Turkey was conducted more reasonably—$10,000 burned up in making one man *canonen futter* What the price now is no one can at present compute accurately, but the various peoples now in conflict are going to have plenty of time in which to count the cost. Surgeon Gen Gorgas, then Col Gorgas, of the United States Army Medical Service, during the building of the Panama Canal saved human life among its builders at the actual cost of $2.43 the individual Sanitation in the Canal Zone under his management took up just 5 per cent of the total canal building expenditures. Nor could that constructive work have been accomplished—every one knows how the French under de Lesseps failed at it—had not devoted and zealous physicians, beginning with Finlay of Havana, so magnificently and with so much altruism, suffering and martyrdom, led up to and [illegible]d the discoveries and the resources of modern medical science to the colossal enterprise. The medical philosophy is indeed all for construction rather than for destruction, for reparation than for devastation Doctors do not kill—not deliberately Some 80,000 clergy are reported to be fighting in the French trenches—all good men, and true enough, to their country, if not to their calling, though there is probably not one doctor engaged in the like business in all Europe to-day, as many thousands, at least, are crippled, or are killed or dying in this war, while engaged in patching up the wounded, of either or any side or army indifferently, in treating camp infections, or while crawling, snake fashion, between trenches, in the hope of applying first aid to the injured and to gather them into motor ambulances. Nor has any discovery in medical science ever been utilized for the destruction or harming of any enemy

It is in such spirit that the Medical Brotherhood for the Furtherance of International Morality has been formed—whose aim is to work for, and to keep working for, world-wide and continuous peace. It hopes to exert its influence on the ground that medical science knows no rational or racial limitations, and would have affiliations no less broad, no less circumscribed, than the universe. Lest some subterranean game perversive of American neutrality be suspected, it is expressly stated not to be the Brotherhood's object to exert its influence during the present war It is, for the present, desired merely to bring to the full consciousness of the medical profession the exceptional moral position which all civilized nations, even while at war, permit and expect medical men to occupy—at least as long as they remain physicians and act in that capacity This consciousness cannot fail to elevate the moral standards of physicians and, at the end of the present war, a humanitarian body such as this, if already in existence and prepared for service, might and could be of the greatest usefulness in many ways.

Automobile Notes

Automobiles for Battleships.—Following the successful use of an automobile by the commanding officer of the battleship "Maryland," other warships of the United States Navy are to be similarly equipped. The automobile on the "Maryland" is the personal property of its captain, but there is a movement on foot to make a medium priced touring car the regular equipment of ships going on long cruises. "Land launches" the sailors have called the motor cars, as they are used both for the official and social calls of the officers.

Vacuum Brake for Light Cars—Tests made recently in England with the Gattrell vacuum brake have shown it to be highly effective on light automobiles, the only essential to their use being the running of the engine. The brake is operated by means of a control valve, which creates a depression in the cylinder, several pounds lower than the outside atmosphere the pressure of which forces the cylinder piston towards the back of the cylinder, thereby drawing on the brake The strength of the braking effort is practically controlled by the speed at which the engine is running The faster the motor has been running at the moment of braking, the greater the power exerted on the brake levers.

What Becomes of Old Cars?—It has generally been assumed that when an automobile begins to show its age it gravitates to the rural districts, but the observing traveler knows that the average farmer likes a new car as well as the city man, it is evident that the fate of used cars, and the reason for the comparatively strong price maintained on them, must be sought in other directions Many second hand cars are bought by small tradesmen, who convert them to commercial uses, but by far the larger number return to their makers, or to the various branches, where they are dissected for the many parts that, with a little cleaning, can be used again thus freeing the shops from the necessity of turning out quantities of parts for replacement stock

Rifle Bullet Wrecks Armored Car—How a rifle bullet accidentally wrecked a large armored *Austin* car, equipped with two machine guns is related in the report of the Hungarian officer, Dr Aladar Szelnar, to the General Staff The car, trusting to its strong steel armor approached the positions of the Hungarian riflemen to within 800 yards and opened a murderous fire on them In the course of the heavy fusillade a bullet from one of the rifles entered through a small crack between plates, and cut the ignition cables at the point where the four wires to the cylinders begin to branch out. When the Austrian artillery finally got the range of the armored car, it attempted to escape, but the motor wouldn't explode The entire crew of two officers and five men was captured—because of the lucky cutting of the ignition cable

Road Repairs—Reports on road work for the past year state that repairs and maintenance cost one third as much as was spent for new roads, and it is pointed out that this is too great a sum As a matter of fact such a comparison is misleading, for the repair account should properly be compared with the total expenditure for road building There is little doubt, however, but that the cost of repairs is too great and the reason is not wholly because the original road was of the wrong kind, or improperly built. Every tourist knows that it is the common custom of those in charge of the roads to allow them to wear almost to the point of disintegration before making any repairs, and then the expense of putting them into good condition again is much greater than would have been the case if the surface had been constantly and systematically maintained. Under present methods it looks as if our roads would have to be practically rebuilt several times before the simple lesson that prevention is cheaper than cure is learned.

Abolishing the Grease Cup.—In the gradual evolution of the modern automobile the original "oil hole" was soon superseded by the oil cup, and the screw down grease cup, which undoubtedly was a great improvement. Now there has been patented a new device which bids fair to supersede grease cups—at least on automobiles, and probably also on other machinery This novel device is patented in Great Britain and is an adaptation of the well-known collapsible lead capsules, so widely used for artists' colors, druggists' products, paste, etc., in the United States. The capsules are provided with a screw thread which is screwed into an adapter, which in turn is fastened to the part to be lubricated The lead capsule and the brass adapter make a tight joint, and all that is necessary is to apply pressure from time to time, as desired When the grease capsule is emptied, one merely unscrews it and puts a new one in its place. No refilling is necessary, and the pressure of the fingers is usually sufficient to force the grease into the bearing Anyone who has attempted to fill an ordinary grease cup will appreciate this suggestion.

Science

Zoological Studies Under the Harriman Fund—For a number of years Dr C Hart Merriam has been making, with the aid of the income from a fund established by Mrs E H Harriman, an exhaustive study of the big bears of America, and this investigation is now practically complete It appears that there are about 88 species and subspecies of true grizzlies, representing a dozen groups, and about ten species of brown bears, representing five groups Dr Merriam will now turn his attention to other fields of biological research

Combined Vaccines for Several Diseases—According to a very interesting report by Dr Aldo Castellani quoted in *Public Health Reports* from a British official source, protection against a number of diseases may be conferred upon a person by the use of several vaccines at one time without any greater inconvenience than is ordinarily caused in being vaccinated to secure protection against one disease Dr Castellani began experiments in this line at Bonn in 1901-02, when he demonstrated ' that in inoculating an animal with two or three species of bacteria provided a sufficient minimum quantity was given, agglutinins and immune bodies for all the germs were elaborated, the amount of agglutinins and immune bodies elaborated for each germ being nearly the same as in animals respectively inoculated with only one species. He enumerates nine combinations of vaccines that he has used on human subjects and states that all are harmless

Recent Explorations in Brazil—Mr Roosevelt has communicated to the American and the Royal Geographical Societies information received by him from Brazil concerning recent explorations in the drainage basin of the Rio Theodoro, the scene of his own explorations An expedition was sent out about a year ago under Lieutenant de Souza to explore the Rio Ananás or Pineapple River which now proves to be identical with the Cardosa of Roosevelt's maps, emptying into the Theodoro in 10 deg 58 min S It is one of the headwater branches of the Theodoro, but not the major tributary that it had been thought to be. The expedition was a disastrous one After suffering from shortness of food and illness, the party was attacked by Indians, and the leader was drowned after being wounded with arrows. The party became scattered, and apparently only three of the ten *camaradas* who had started with de Souza, finally reached the Dúvida and ultimately got back to civilization

Double Report from Firearms—A paper by M Agnus, in the *Comptes rendus*, describes and discusses the phenomenon frequently noted during the present European war, of a double report from a gun The explanation depends upon the fact that, in these cases, the velocity of the projectile is considerably greater than that of the explosion wave starting from the muzzle at the same time with the projectile. If the observer is near the trajectory of the projectile, his first aural impression is due to the disturbance arising from the passage of the latter through the air, while the second is due to the arrival of the explosion wave. In the case of the 75 mm shrapnel shell the writer calculates the time intervals between the reports, at various distances in front of the cannon, as follows 100 meters 0 1 sec., 500 m 0 5 sec., 1,000 m, 0 8 sec, 2,200 m, 1.2 sec. For greater distances the projectile loses sufficient headway on account of the air resistance to diminish the time interval M Agnus suggests that the violent detonation so often reported in connection with brilliant meteors, and commonly attributed to the explosion of these bodies may often be due rather to the violent disturbance of the air by the passage of the meteorite through it.

The Crushing of a Copper Tube Lightning Rod by a discharge of lightning has recently been investigated by Prof W J Humphreys, of the U S Weather Bureau, who draws some interesting conclusions as to the strength of current and the amount of electricity involved in producing this effect. The damaged rod was submitted to the Bureau, together with an undamaged rod of identical size and pattern The crushed tube was five feet long, and constituted the terminal of the lightning conductor It was completely collapsed, except for a part of the conical tip, which was a separate piece of metal Parts of the rod were fused, and the brazing solder along the joints was almost completely volatilized. Prof Humphreys concludes that the collapse was an example of the "pinch phenomenon", *i. e*, a squeezing effect due to the interaction of the magnetic fields set up by the current The walls of the tube were, of course, weakened by heating, and hence more susceptible to the effects of this squeeze From the amount of fusing and crushing, and the known physical constants of the metal, the strength of current appears to have been of the order of 90,000 amperes, and assuming the duration of discharge to have been 0.01 second, the quantity of electricity would be about 900 coulombs.

Inventions

A Pressed Steel Stairway—A newly patented pressed steel stair consists of a tread and riser in a single sheet the tread being formed with a curved nose and the riser terminating in an angularly extended lip these two parts of adjoining steps locking together when in place

Projecting One Film on Two Screens—One moving picture apparatus may be made to serve two audiences by means of a recently patented arrangement. In one wing of an L shaped hall the picture is shown on a screen as usual while the audience in the other wing views the reflected picture on a mirror placed back of the fabric curtain and at an angle of forty five degrees to it

Electric Fuses Sealed in Place—A system of sealing electric fuse plugs has been devised for the use of central station managers to prevent unauthorized persons from tampering with the circuits The new fuse is of porcelain, with a slotted head so that a wire may be passed through two more fuses When the ends of this wire are sealed with a piece of soft lead any effort to substitute one fuse for another or to put a fuse in place when the service has been cut off for any reason, will be detected by the employes of the electric company

Sanitary Device for Dentists—Among the patents recently granted is one for a corrugated paper covering to be placed over the exposed parts of a dentist's implement, for the purpose of protecting one patient against contamination by contact with the metal part which has been in the mouth of another While it is true that sterilization is largely resorted to at the present time, there are many implements that cannot be readily sterilized because of their delicacy, but one of these paper coverings used on each occasion places the dentist's implements beyond suspicion

One Light for Several Rooms—The efficiency of the electric lamp is doubled or trebled, as the case may be by means of a system recently patented by William M Grosvenor of Grantwood, N J, who proposes to dispose of the source of illumination in an opening in the wall so that the lamp's rays may be shed into two or three rooms or compartments at the same time This is said to answer all purpose where a moderate illumination is desired, such as in bed rooms or hallways The openings into each room are protected by frosted or ribbed glass so that the privacy of any of the rooms served by the lamp may not be interfered with and shutters are provided in order that the light may be excluded from any of the rooms when it is so desired

Focussing and Finding Device for Cameras—Carl E Akeley of New York, who is responsible for a number of important improvements in cameras for scientific research, has recently secured a patent on a combined finding and focussing device in which an oblique reflector is adapted to be brought into axial alinement with either the photographic lens or the finding lens, as desired This invention simplifies the camera construction by eliminating the ground glass and the necessity for consulting it in order to get the picture in accurate focus. Mr Akeley's improvement is designed particularly as a feature of a new moving picture camera for scientific work, which he has devised

New Engine for Dentists—The terror inspiring aspect of the engine which is part of the equipment of the dentist's office has been removed by the invention of a new engine of very much smaller proportions and unobjectionable appearance The new engine is cylindrical in shape 1¼ inches in diameter and of not much greater length The tool to be used is mounted on the end of the new engine A flexible cord connects it with the source of current, and its operation is controlled by a device placed on the floor in easy reach of the operator's foot It is capable of four speeds and reverse making from 600 to 2,800 revolutions per minute Its action being direct, with a total absence of gears the engine runs almost noiselessly and with very little vibration

Compass That Indicates the Time—By a slight modification in the ordinary pocket compass it has been transformed into a very practical timepiece for indicating the hour by the shadow of the sun In addition to the usual "points," there is a graduated hour scale with the two twelves at the North and South. The crystal by which the magnetic needle is protected has a line etched across it through the center and it is mounted in a bezel which permits of the glass being rotatably moved Knowing the variation of the compass, an adjustment of the glass is made to overcome it, the etched line forming an angle with the North and South line corresponding with the variation The instrument being held horizontally and the etched line being directed against the sun, the time is indicated by the needle, the point of which overhangs the graduated hour scale

Young naval recruits learning the rudiments of wig-wag signalling

At the Newport naval training station. Physical training exercises

Our Navy as a Schoolhouse

Success of the New System in the First Year of Its Operation

By E K Roden

UNTIL quite recently a man's advancement in the Navy depended entirely upon himself If he was capable and in earnest to improve himself the greater his success as measured by rank and pay If on the other hand he showed disinclination or incapacity to advance he would quit the service for good at the end of his four year enlistment Now a new order of things prevails in the Navy An enlisted man must study not only subjects pertaining to his duties aboard ship, but also if need be the Three R's

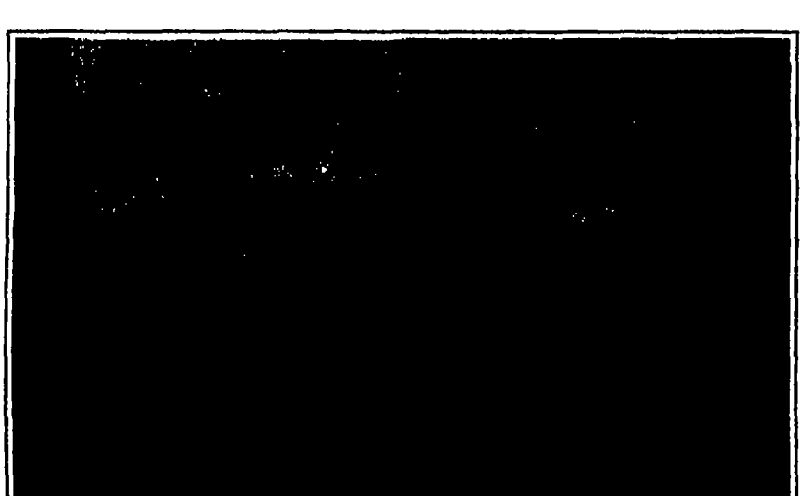
Under the new Navy regulations academic instruction is compulsory for all enlisted men, in the first two years of their first enlistment, who are found deficient in common school branches as determined at the training stations or upon enlistment, or by examination The only exception to this rule are men who have served in the Navy for more than two years and those whose educational attainments are such as to meet the requirements prescribed by the Navy Department But all men may study and receive academic instruction if they so choose even though they may be exempt by existing rules

The new regulations were put into effect January 1st, 1914 the purpose being to supply the need for academic education and also to provide systematic means by which all enlisted men and warrant officers may receive the assistance and encouragement in technical branches necessary to fit them for promotion in the Navy, or which will better prepare them for civil trades at the end of their enlistment Under this plan the ship's routine includes a period each day set aside for instruction during which no work is required except in cases of emergency or necessity, the instruction being conducted by officers of the ship assigned for this duty

An evidence of the interest the enlisted men are taking in the new system is shown by a recent report received by the Navy Department from the Asiatic fleet giving the number of men on each ship receiving instruction The list follows

	Compulsory	Voluntary
U S Destroyer Chauncey	13	11
U S Tug Wompatuck	-	25 (all)
U S Monitor Monadnock	5	8
U S Gunboat Samar	5	3
U S Gunboat Quiros	0	11
U S Gunboat Villalobos	0	12
U S Gunboat Elcano	8	2
U S Gunboat Helena	30	6
Submarine Flotilla	41	28
U S Destroyer Dale	7	25
U S Cruiser Saratoga	125	52
U S Cruiser Cincinnati	73	75
Total	307	258

Bluejackets being taught the mysteries of wireless telegraphy Here they are seen at code practice, taking down on paper the test messages



Practical lessons in the care and repair of electrical apparatus

The most striking feature of the report is the large number of men exempt from compulsory study who participate in classwork of their own volition Other divisions of the fleet show the same percentage of scholars in their crews

The result of the system in the first year of its operation is evidenced by the promotion of enlisted men to warrant rank. During 1914 no less than 77 men were appointed warrant officers as follows boatswains, 18, gunners, 20, machinists, 27, carpenters 11, pharmacists 1 The figures for the past year are not yet available but the indications are they will greatly exceed those of 1914

Not only are enlisted men given the opportunity to advance to warrant rank, but a chance is also accorded them to become commissioned officers by the new system The act authorizing the appointment each year of 15 enlisted men of the Navy as midshipmen at the Naval Academy was passed June, 1914 Any enlisted man under 20 years of age and who has had one year's service in the Navy is eligible for the examination In 1914 the candidates had only a little over one month's time in which to prepare for the examination which was held on August 3rd One hundred and fifteen candidates were examined, five passed, three of them coming from the same ship, the U S S "Maryland" In 1915 there were 55 candidates, ten of whom passed the mental examination Of these, six have entered the Academy as midshipmen and four were ordered to the Naval Hospital, Washington D C, for treatment of physical defects in order that they be given every opportunity to qualify for appointment in October this year The five who entered in 1914 are still at the Academy and have excellent records

The names of the successful men and their former rating are given below

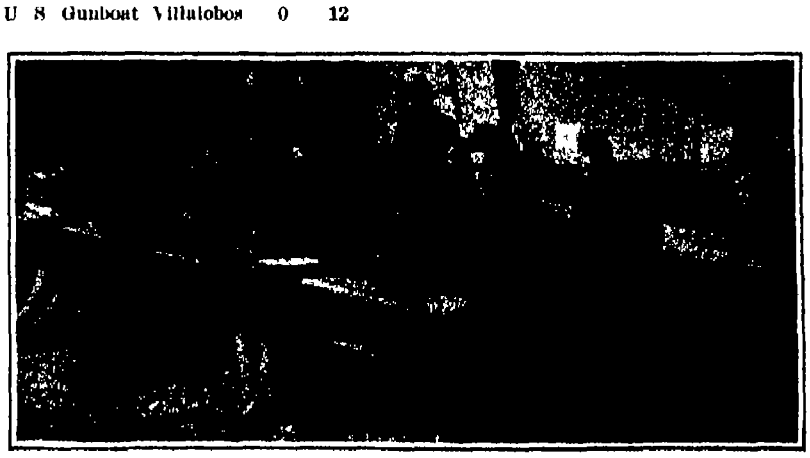
1914

Name, rating, and state

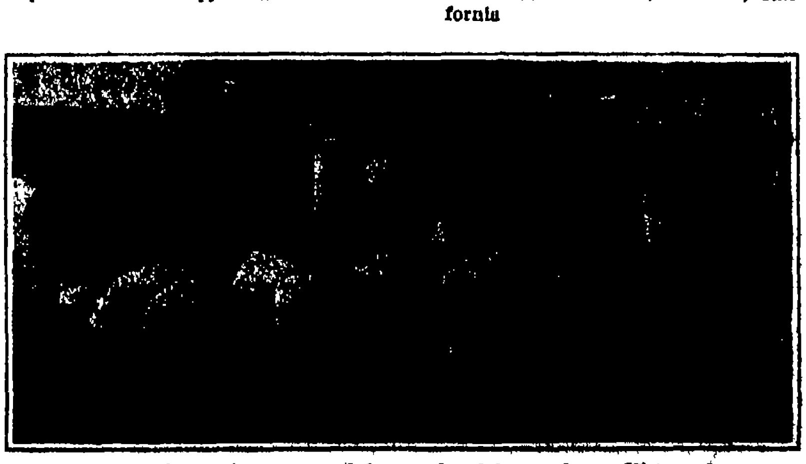
W Busk, Ordinary Seaman, Nebraska
H S Corbett, Seaman, Massachusetts
A L Hungate, Jr, Ordinary Seaman Indiana
J W Rowe, Musician, 2d Class, Wisconsin
W W Warlick, Seaman, California

1915

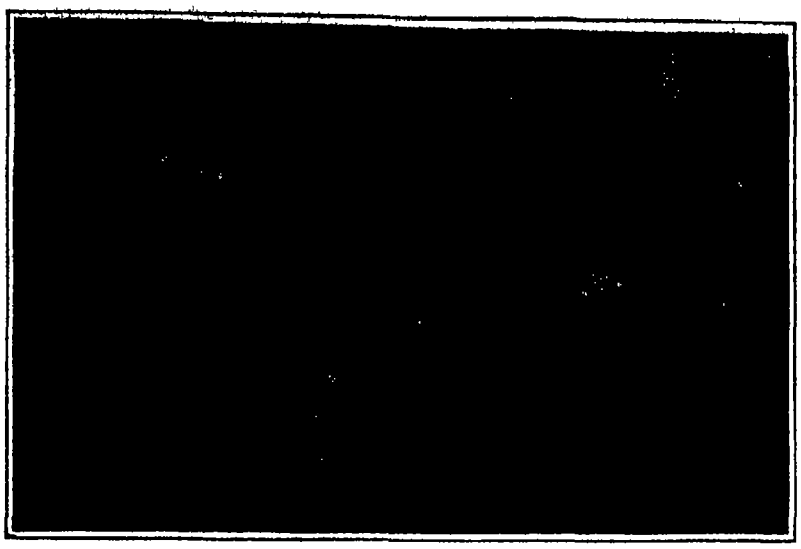
J G Atkins, Seaman, Wisconsin.
T O Brandon, Seaman, Indiana.
B F Collins, Ordinary Seaman, Illinois
W B. Cooley, Electrician, 3d Class, California



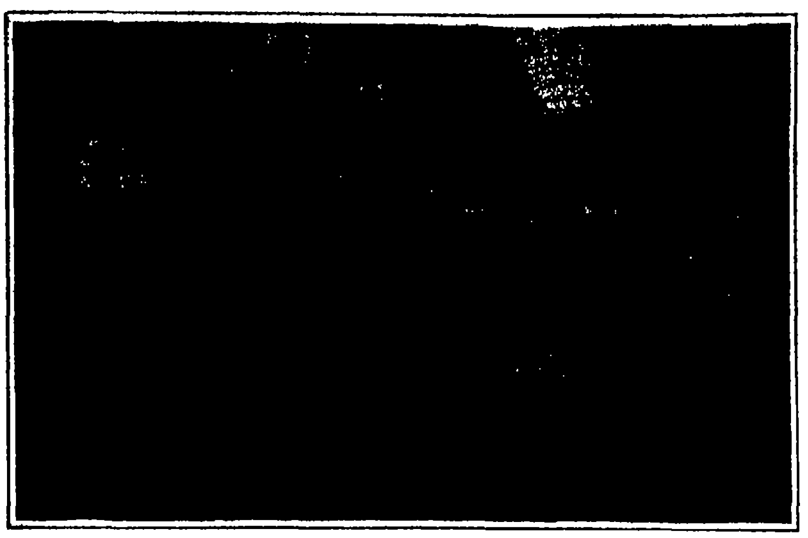
Enlisted men receiving instructions in the operation of typewriting machines



Academic instruction at one of the naval training stations. History class



Practical instruction on the operation of electrical machinery



Developing enlisted men into practical machinists Class for machinist mates

Roy E. Druet, Electrician, 3d Class, Louisiana.
H M Jackson, Ordinary Seaman, Virginia
J B Noble, Seaman, Texas
C. H. Schildhauer, Hospital Apprentice, Wisconsin
S L. Wells, Ordinary Seaman, Colorado
H S. Woodman, Hospital Apprentice, California.

In line with the general educational scheme afloat, academic studies now form an important part of the instruction at the several training stations where the facilities for this class of work are excellent Another agency provided by the Government for the benefit of the men afloat and one which especially distinguishes the new Navy from the old is the library aboard ship Ample funds have been provided for all needful purposes, and a generous supply of books is placed at the disposal of the service Thus a battleship is allowed 500 books for its crew's library and 300 volumes for its ship's library—assuredly a liberal allowance, and with the privilege of exchanging old, unacceptable or obsolete books at frequent intervals for new works, this allowance of 800 volumes constitutes a valuable storehouse of knowledge and recreation for the ship's company

Whatever success the new system will attain as a permanent feature of the navy, two things are certain It makes the naval service more attractive and it gives to the young enlisted man with grit and ambition a chance to succeed equal to that of his compatriot at the Naval Academy, it will substitute for the careless, rollicking, and more or less disreputable seaman of former days, an entirely new type of man-of-war'sman—active, alert, intelligent and educated, respecting himself and respected by his officers, well paid, well fed, and well clothed, surrounded by comforts of which the sea faring man of a score or more years ago knew nothing, with the certainty of rapid advancement in rate and pay if he is faithful and industrious, and with a possibility of promotion to the rank of commissioned officer

Motorcycle-Radio Stations as a Factor in Military Operations

CORPORAL GREENHOW JOHNSTON, of Richmond, Va organized a motor cycle squad of eight men for auxiliary service in the Signal Corps of the Virginia Volunteers on January 21st 1915 It is reported that the military value of motor cycles has been significantly proven by the exploits of this volunteer organization especially in connection with portable wireless stations, which have been carried with marked rapidity from point to point over roads little better than foot paths, and readily set up and operated

The following is quoted from a report sent by Capt F S. Splatt, Type D Signal Corps Virginia Volunteers, to the Adjutant General of Virginia, relative to the subject of the volunteer motorcycle squad

"In accordance with the policy outlined by the commander of the company, this command assembled 8 A.M., November 7th, for mounted practice. Forty-five men and one officer reported. One wire cart, one wagon and two pack mules were used. The motorcycle squad recently organized in the company was used for the first time. The command left the armory 9 A.M., and proceeded to the state fair grounds in regular formation. One ration was carried.

Equation exercises were given for about two hours followed by section drill of about one hour's duration Wire lines were laid within the fair grounds, communication was excellent One radio station was erected at Byrd Park, several miles away and one at headquarters (fair grounds) Communication was instantaneous and perfect The radio pack sets are a success in every way

'I cannot speak too highly of the speed and efficiency of the motorcycle section this branch of the work is really a side issue of signal corps work and has never been authorized by the War Department I commend its adoption by the state forces and ask that you recommend the same to the War Department The great speed over the pack mules, and the ability to get over the ground almost as well as the pack mules are the good features

"The expenses incident to the work by the motor cycle squad have been paid by the individual owners of these machines The company commander approves that these owners should be reimbursed for fuel and wear and tear on the machines out of the funds allotted for practice drills.

'I consider the practice drill a success a great help to the organization'

It may be of interest to add that the wireless sets used by the volunteer organization are of the standard United States Army pack type, equipped with a pole made in sections and a hand-driven generator Practically no alterations are necessary in converting the standard motorcycle fitted with a side car into a motor cycle wireless plant

Motorcycle squad and wireless apparatus of the Signal Corps, Virginia Volunteers

Standard wireless pack set of the United States Army, carried on a motorcycle side car

The Current Supplement

THE leading article, *Evolution in Shipbuilding*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No 2095 for February 26th, 1916 is a résumé of the wonderful progress that has been made during the last century, and is of particular interest in view of the remarkable demand for marine transportation made necessary by current events *Aerial Torpedoes* describes the small trench mortars with their curious projectiles, which are being used extensively by all combatants in Europe, and it is fully illustrated *Some Noted Zoological Parks* describes and illustrates the gardens of the Royal Zoological and Acclimatisation Society of Victoria in Melbourne This is one of a series of articles that are appearing in the SUPPLEMENT *School Spread of Contagious Diseases* discusses a subject of vital importance in every community, to which but scant attention has been given either by the authorities or by medical men. It should be read by everyone *Explosives* contains interesting facts relating to the history of the most important material used in the war and one that is daily becoming more important in domestic use for purposes of peace *Temperature Inversions in Relation to Frosts* gives some methods of anticipating critical periods as related to crops and is worthy of the attention of those engaged in agricultural pursuits *A Metallographic Description of Some Ancient Peruvian Bronzes* is a study of archeological relics from a new point of view that may be of ultimate value in modern commercial processes Among other articles of general interest in this issue are *The Relative Stimulating Efficiency of Spectral Colors for Lower Organisms* *Hints on Judging Diamonds* and *The Early Days of the Railroad*

Motorboat Submarine Destroyers for U S Navy

PLANS for two types of motorboat submarine destroyers designed to have a speed of at least 41 miles an hour have been submitted to the Navy Department Models will be constructed at once at the Washington Navy Yard and tested to determine whether the engines the designers propose to install will develop power for the required high speed

The Department recently obtained bids from several boat builders on craft of this type but there was such a wide variation in the power proposed for boats of approximately the same size and lines that a test was decided on to determine just how much power would be required

The boats are primarily intended to be carried aboard capital ships two to a battle cruiser, and to form an inner protective screen against submarines when a fleet or squadron is at anchor or cruising slowly on station at sea From the experiments with these craft however a standard type of motorboat for submarine patrol duty along the coasts and off harbor entrances in time of war probably will be developed

Industrial Preparedness for Peace

The Possibility of a Permanent Dyestuff Industry

By Wallace P. Cohoe

AMERICANS have a reputation for ingenuity and resourcefulness Now we are being put to the test Without the slightest warning we find ourselves cut off from certain imports that are vital to our manufactures What are we going to do? Here is the answer of one intrepid firm It is engaged in the manufacture of hosiery Suddenly it was confronted with a shortage of black dye—a dye that must be proof against wear, light and soap Unable to buy the dye the firm launched into the manufacture of its own coloring materials It is an inspiring story, one of many instances of American enterprise, showing that we can make good when put to the test —EDITOR.

HOW are colors extracted from coal tar? This question is frequently asked by the uninitiated It is sometimes asked by those who should know better One popular conception seems to be that colors may be produced by putting coal tar into one end of a piece of machinery—the wheels turn, and the colors come out at the other end By suitable arrangement of levers the machine may be made to turn out reds, blues, yellows and all combinations of them

About next Easter ladies will find that American ingenuity has not yet been able to produce any such machine Certain colors are now practically out of the market Others are fast being exhausted One mill has thousands of yards waiting to be dyed green Manufacturers are asking where they are to obtain dyes when the present stock runs out

The story of how one firm began to answer the question of shortage may be interesting This firm has been for some years successfully engaged in the manufacture of hosiery It is located near Chicago One extensive line of hosiery consists of heavy cotton stockings which are dyed black These goods meet a general demand and are sold everywhere It is a popular line The dye used must be fast to wear, fast to light, and fast to soap and water To get this fast black, aniline is used as the basis of the color

Some months ago, my friends were confronted with a serious problem Aniline could only be obtained in limited quantities and at exorbitant prices. Black dyes are very heavy, that is to say, a large amount of coloring matter must be used on a pound of goods to produce a good shade Aniline, which before the war had sold around ten cents a pound was costing as high as one dollar and seventy five cents per pound How could a hosiery manufacturer continue a popular line under such a set of conditions?

Fortunately these people had resource and courage They decided that they would make their own aniline Many wise men, particularly those with vested interests in dyes, very solemnly wagged their heads. It was folly for a knitting mill to make aniline colors. My friends were not deterred, however, by this head wagging They decided to back their own judgment with their own money They had a plant designed It was ordered Raw materials were bought. The plant was erected and is now turning out a ton of aniline each day When more apparatus, now on order, shall have arrived they will be making two tons of aniline each day

As some readers of the SCIENTIFIC AMERICAN may not be familiar with the process of making aniline, I will briefly outline it. The raw materials consist of benzol, sulfuric acid, nitric acid, hydrochloric acid, and iron turnings Benzol is a light colorless liquid produced when coal is distilled either in gas retorts or in coke ovens The other materials do not need any description as everyone is familiar with them

The first operation consists in treating benzol with a mixture in proper proportions of sulfuric and nitric acids. The nitric acid attacks the benzol and there is produced a yellow, heavy, oily, liquid known as nitrobenzol This substance has a peculiar odor and on this account it is used to give a perfume to shoe polishes and greases. It is sometimes called oil of myrbane The manufacture of nitro-benzol is conducted in a large iron vessel provided with cooling arrangements and a stirrer Into this vessel a charge of benzol is run A usual charge in full sized plants is 500 gallons Into this benzol with constant stirring is run a fine stream of the mixed acids If the proper conditions have been maintained shortly after all the necessary acid has been added all the benzol will have been converted into nitro benzol The acid and the nitrobenzol are separated by gravity the acid drawn off and the nitro benzol is washed and put into storage ready for the next operation

The next operation is called reduction The reducer is a heavy iron vessel provided with a central vertical shaft to which is fastened a heavy rake This rake is designed to agitate the contents of the vessel It runs as near to the bottom as possible Hot water is introduced into the vessel, the necessary amount of hydrochloric acid and some nitro-benzol are added Cast iron turnings are now slowly fed into the vessel from a funnel at the top When properly managed, the chemical action starts at once Iron must not be added too rapidly but only so fast as to maintain a temperature near the boiling point. Gradually the full quantities of iron and nitro-benzol are added This operation requires about 12 hours. Shortly after the last iron is added the operation is complete. Steam is turned on and the aniline distilled and condensed The crude aniline thus produced is usually but not always purified by distillation In the plant referred to above the reducers have a capacity of 1,800 gallons This size permits a working charge of 2,500 pounds of nitrobenzol, producing upward of 1,800 pounds of aniline

Dye plant built by a hosiery company

Thus, starting with benzol extracted from coal tar by nitration and subsequent reduction, aniline is produced in these quantities daily But aniline is not in itself a dye By itself alone it will not impart a color to a fabric Aniline belongs to a large class of substances which color makers call intermediates From these intermediates, the colors themselves are produced It is seen then that in the color industry there are essentially three general classes of substance We have first the crudes of which benzol toluol, naphthalene and anthracene are examples From the crudes, intermediates are made, of this class, aniline toluidine, benzidine, phenylene diamine, salicylic acid, benzaldehyde, the naphthols and alizarene are a few examples of the many By the chemical treatment of the intermediates or by the chemical combination of two or more intermediates are the hundreds of dyes produced.

The problem of the color manufacturer in building up the complex chemical structures called dyes may be roughly compared to the problem of building a physical structure Suppose one wishes to build an ordinary house, consisting of bricks, lumber, nails, sand and lime All these materials are necessary but they in their turn must first be made from crude materials. The bricks are formed from clay and burned Trees are cut in the forest, sawn into lumber, seasoned and dressed. Iron ore is smelted, converted, rolled into bars, drawn into iron and made into nails. Limestone is quarried and burned Thus the crude materials are made into manufactured materials and by using these latter the builder produces a structure. So in the chemical field from the crudes are manufactured the intermediate manufactured products. The chemist takes these intermediates and by various methods builds the chemical structure which we call a dye.

It will be seen then that the manufacture of dyes is something more than the mere extraction of colors from coal tar

I have endeavored to outline above some of the general features of the color industry and to illustrate by a concrete case an attempt on the part of an American industry to solve one of its serious problems.

Just here, we may well ask two questions. First Do we want a permanent dyestuff industry in America? Second Can we have a permanent dyestuff industry?

Some years ago, the leading textile interests did not want a permanent dyestuff industry in America, at least, not if such an industry required tariff protection To-day these same interests after a most unhappy experience of several months' duration have said never again do we want this experience Let us have a permanent dyestuff industry here in America We wish to be industrially as independent in the matter of dyestuffs as we are in the matter of cotton or steel

This brings us then to the second question Can we have a permanent dyestuff industry in America?

Looking at the physical side of the question, the amount and availability of raw materials naturally come up first. These raw materials naturally fall into two classes First, there are the coal tar derivatives which go into the manufacture of crudes, and in the second place, we have the heavy chemicals which are necessary in the working up of the above

With respect to the coal tar derivatives, it may be said that this country has a supply of raw materials quite large enough and to spare for all its present and future needs as far as the latter can be forecasted to-day Coal tar derivatives may be obtained wherever coal gas or coke is made in by product ovens Until recently the lighter distillates from coke ovens were burned, but the demand for benzol and toluol to be made into explosives became so great that many recovery plants were installed To-day, thousands of gallons of benzol per day are recovered at individual plants where previously they were wasted. Generally speaking, it may be said that as long as we have a steel industry in this country just so long shall we have the coal tar derivatives necessary for a dyestuff industry

In the second place, we ask whether there is a sufficient supply of the heavy chemicals necessary Most important among these chemicals are sulfuric acid, nitric acid, hydrochloric acid, caustic soda, soda ash and chlorine. The answer to the question is most emphatically in the affirmative. In fact, we are making them to-day and they are being used in the manufacture of explosives. When the vast quantities of these materials now being made daily shall be released for use for other purposes, we shall have an abundance of heavy chemicals for a dyestuff industry

This leads, however, to a present difficulty Many people are willing to start upon the manufacture of colors at once. When they endeavor to secure the chemicals necessary, however, they are halted by the extremely high prices asked for them. This is only a temporary condition, of course, but it is one reason why America has not made more of a start towards a dyestuff industry When the war is over and munition contracts are filled, then supplies of chemicals will be easy and prices will drop first to normal and then possibly to levels lower than before.

(Concluded on page 238)

General Staff Maps

Importance of Military Maps in Modern Warfare

By Lieut. Guido von Horvath

In order to give our readers an insight into the modern military tactics and strategy we have arranged with Guido von Horvath, a former lieutenant of the Austrian-Hungarian Army, to conduct a War Game series in the columns of the Scientific American *The subject will be introduced and carried out without the use of technical terms, except where unavoidable, and every effort will be made to present the matter so clearly that it can be readily understood by the lay reader The series will start with operations on a small scale working up the units of all three sections of the army combined in a division.*

The author of the series has had a very interesting career He became lieutenant in 1894, and on account of his talent as an artist, was a year later commanded to the Military Geographical Institute of Vienna, a branch of the General Staff Two years special training ended with an interesting commission as Honorary Ordnance Officer to His Majesty Musaffer Edin of Persia, whom the lieutenant accompanied to the Persian capital, Teheran

Upon von Horvath's return to his own country he was promoted to first lieutenant and served in the famous Nadasdy Hussars He partook in the international policing service of the Island of Crete

In peace-time service he was wounded by a crazed soldier which disabled him for active service and brought him the medal of bravery Under the climatic conditions of his own country he had no hope of recovery, he accepted a commission in Brazil and there had active service of topographical and military character

After almost two years' struggle in the Amazon country, he decided that the tropics did not agree with him and, ill with yellow fever and just recovering from another wound, he returned to his home country, thence he came to the United States

Lieut von Harvath has followed the preparedness question which is now agitating this country with great interest, and has offered his services to the United States

The present article is an introduction to the War Game series It explains the importance of true maps in warfare, and shows what a wealth of information is to be found in a modern military map In a succeeding issue, Lieut von Horvath will present the first of the War Game series —Editor.

THERE is nothing more important in the conducting of modern warfare than absolutely true military maps.

In the eyes of the public a map generally represents a somewhat uncertain guide, of mysterious character, therefore the public does not realize the momentous services rendered by war or general staff maps.

In the war of 1870-71, France was a great deal handicapped by the lack of reliable maps. They possessed maps of Germany made by the German general staff, but they never had occasion to use them.

All the warring European nations are provided with war maps, with the exception of parts of the Balkans. These maps are not handled as secret documents—civilians can buy them without any trouble—but to read them is another matter To be able to understand them thoroughly, one must have a special training in every detail Every officer commissioned or non-commissioned, is taught the use the reading and the making of these maps. Every tactical and a great many strategical operations are planned on these maps. Besides ranges for artillery of all calibers, the movements of troops, the selection of the battle grounds the provisioning, the quartering the disposing of the wounded, in fact, almost every military plan is based on these maps. The immense scope of modern tactical operations could not be controlled by the Centralized General Staff without them.

The providing for military maps of absolute accuracy is an institution of a century's growth It was first introduced in Bavaria, and from there it was adopted in the early sixties by Prussia and also Austria Hungary

The Germans have developed their maps as well as every other detail of their wonderful military machine to a marvelous extent but nevertheless, those who are familiar with this subject will have to admit that the Austro-Hungarian General Staff maps are in many respects even superior to the German

Nothing can show the importance and the condensed information contained on such a map better than a study of the accompanying fragment from an Austro-Hungarian style map

The enlarged section on a regulation 1 to 75,000 map occupies a square inch. The 1 centimeter on the map equals 75,000 centimeters or 750 meters on the terrain.

An officer trained in the reading of this map has the following positive information at his disposal

From N to S a regulation single track railroad runs through the section. From N to S the track is on an embankment, which is important as a line of defense. The bridges, three in number, are of steel construction. There is a siding at the village where the depot is located The depot is outfitted with telegraph and telephone connections West from this railroad in the upper corner, a hill 27 meters high is marked with a triangulation point. Right behind this is a group of large trees, while on the sloping western side a highway comes toward the three arched stone understructure bridge, with wooden railing, which spans the creek. This road turns parallel with the railroad and enters the village. The road is wide enough to permit the passage of double rows of vehicles both ways. It retains its width throughout the village.

The village has a population of 327 people, a mail and mail coach service.

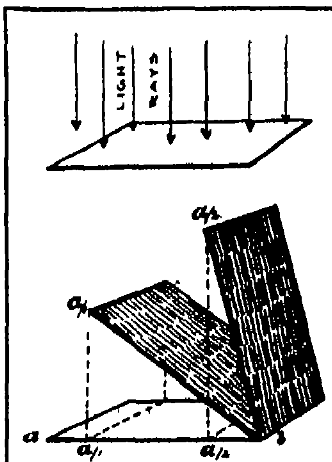


Fig. 1 How sloping ground is shown by shading

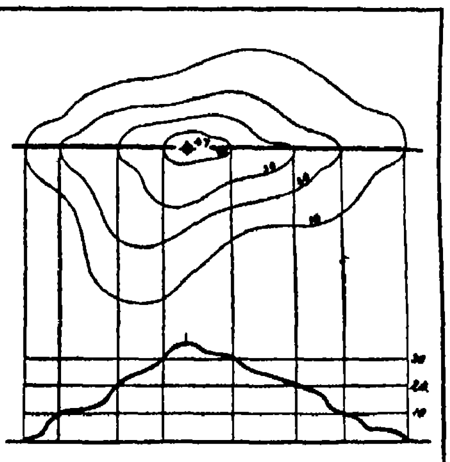
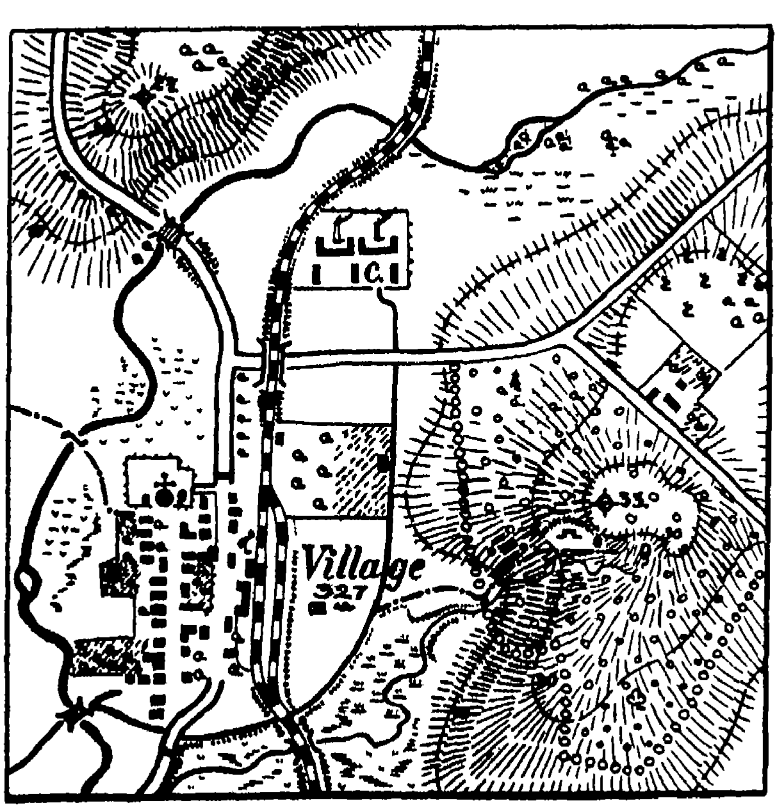


Fig 2. Method of showing elevations by profile lines



Section of a typical military map

The Catholic church has one spire and is located in the cemetery, which has stone walls surrounding it The village has plenty of trees and vegetable gardens The houses are built of masonry and the village has a good defensive front toward the west

The creek in the N E corner is lined with trees and is rather swampy The island is wooded with a bushy sort of growth also the groups east are rather thick The creek has tendencies to overflow, is bordered with grazing lands and in places with rushes It is difficult to ford. A single track road not always passable crosses it west from the church yard there is a temporary bridge across that is not passable by artillery and heavy train In the S W corner on a country road is a well kept bridge of wooden understructure with planks and railing From this bridge the country road goes with a short branch into the village and the other branch goes directly east, crosses the highway and railroad at even level then turns north South from this road is a stretch of difficult swampy ground with a creek, the source of which is right under the top of hill 33. There is a stone quarry in its vicinity and a road not always passable leads to it. This creek runs through a ravine Its water is potable The hill is covered with a forest of tall oak on the S E side and is bushy on the farthest northern point, mingling with pines The roads forking at almost right angle are first class country roads. In this fork is a farm and vineyard etc

There is no use in going further in order to convince anyone that with those cleverly devised signs which in many cases are pliable for finer expressions, one can show on a square inch much more and at a glance, to those who can read this language, than with several lengthy treatises

With this information, are given the absolutely correct distances. Of course these distances are air line figures, which are all that is needed for the artillery and infantry fire range, but here another question arises The unevenness of the terrain, the hills, mountains, valleys and other hindrances, which are sure to influence the movements of the troop must be considered and must be known just as exactly as the air lines for the range.

The system which gives the best service to express the unevenness of the terrain was invented by the Austro Hungarian Colonel Lehman and the scale he devised is called the Lehman scale To make this question clear, it is best to examine the diagram, showing the plan and the section of a hill

Any unevenness of the ground amounting to more than ten feet is recorded through this system The theory is to imagine that every hill or mountain is built up of slices and where those slices come to the surface there is a visible line on the map which is termed a contour line In the above diagram this is shown very clearly

After a little closer observation the question looms up What is the meaning of the closeness of the contour lines, or the larger distances between the same? The answer is very simple In the first case the fall of the ground is more rapid than in the other, where the contour lines are farther apart The wider the contours the easier the slope

All this is clearly expressed by the contour lines, but what happens to be between these lines is not considered when only contours are used Whether the

(Concluded on page 229)

Preparing to Meet a Coal Shortage

Problems of Storing Coal

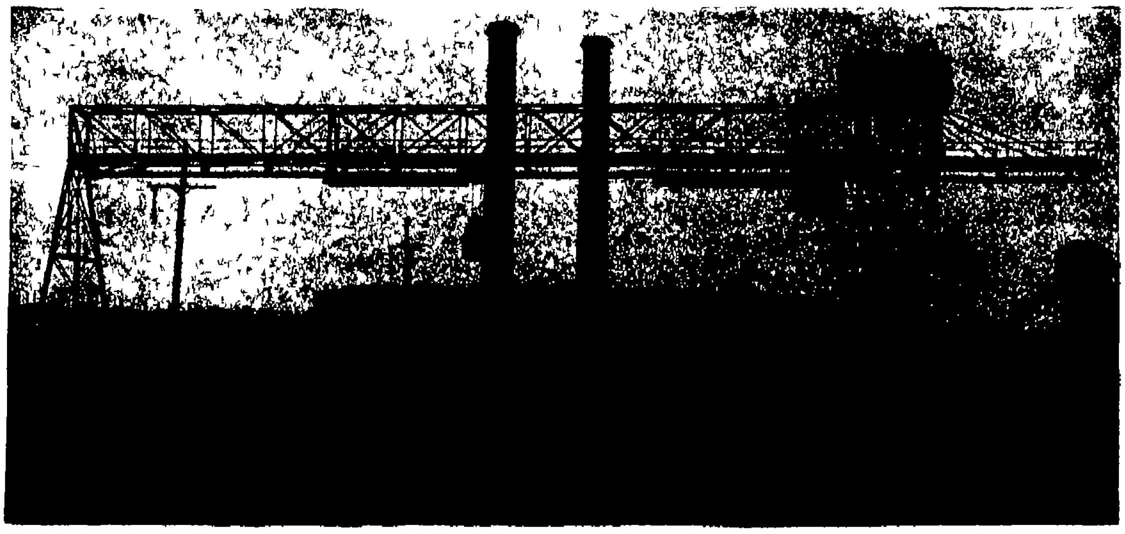
By C. E. Lesher, of the United States Geological Survey

ON the first of next April all wage agreements between the coal operators and the miners' union in both the anthracite and soft coal fields will expire. The agreements now in effect were made in the bituminous fields in 1914 for two years and in the anthracite fields in 1912 for four years. No one is now in position to state whether or not there will be a shut down at the mines before the new agreements are reached but as long as there is a possibility of such a contingency consumers of coal for self protection should prepare to meet it. There is a small stock of anthracite in the hands of the "hard-coal" railroads upon which the retailer and small consumer can depend but no stored supply of soft coal exists against which the ordinary consumer can draw. The railroads and their large users of coal have already begun storing and there are now between 3,000,000 and 5,000,000 tons of soft coal in stock piles, mostly of an emergency character.

Although the miners' union has expressed a willingness to continue work at the mines after April 1st, during the progress of negotiations the experience of the companies in past years indicates that time will be lost through temporary suspensions and that there is always the possibility of deadlock and a strike in some portion of the coal fields. It is just this possibility—cessation of mining operations through suspension or strike with resultant lack of coal supply—that is beginning to cause the user of coal, the "innocent bystander," to ponder seriously over what he will do to meet the contingency. The coal industry, particularly the bituminous-coal industry, is a hand to mouth affair. Probably the greater part of the soft coal mined is sold or contracted for before it is touched with pick and shovel, and most of it is used almost as soon as it is received. In ordinary times the only supply of coal above ground is that in railroad cars in transit, and this quantity when the demand is as strong as it has been for the past several months will suffice the consumers' needs for but very few days at most. For the railroads, factories, mills, smelters and thousands and thousands of small users of coal the shutting off of even a portion of the supply for so short a time as a few weeks or months is a serious matter and one that calls for foresight and preparation.

Coal-mine operators and owners are not prepared to store coal. Shipping mines are equipped to dump coal directly from mine cars through the tipple into railroad cars, and where operators (as in southern Illinois, during the past year) have undertaken to store part of their product, they have been under the necessity of unloading coal from railroad cars on to the ground and reloading as the demand for the coal arises. A great many coal mines in this country, particularly in the eastern or Appalachian fields, are located in narrow valleys and have no ground space close by on which satisfactory storage facilities can be provided. This disadvantage might be largely overcome, however, if the mine operators were able and willing to undertake storage on a large scale. The greatest difficulty arises from the cost. The average coal mining operation is conducted on such a narrow margin of profit that, all things considered, the individual producer is not able financially to undertake the storage of his product, but even if the producer were in position to keep on hand a large supply of coal it should not be stored at the mine. The logical place for storage is at or near the point of consumption.

The carriers of coal—the railroads—can not be expected, of course, to store coal except for their own use. In the anthracite region the comparative smallness of the field and the close relations between the operators and the railroads do permit storage in an admirable manner, of the excess of production over consumption. During the last summer the domestic consumer of anthracite did not, to the extent of former years, take advantage of reduced summer prices and lay in his winter supply of fuel and the result was that to keep the mines going at anything like the normal rate, the anthracite operators were obliged to turn their product over to the railroads for storage. It has been estimated that at the first of this year the quantity of anthracite in the storage piles of the hard-coal roads was not less than 5,000,000 tons. It is maintained that this is the natural result of slack conditions, last winter and last summer, and has not been done to meet the possible contingency of a strike, but it is comforting to know that some coal is available, in the event that there should be a prolonged shut-down of the anthracite mines. It should be pointed out that this quantity is small and that it has not been divulged just what sizes are in storage.



A type of coal storage and handling apparatus suitable for industrial plants, locomotive coaling stations, etc., in quantities from 10,000 to 20,000 tons

Concrete pit, 300 feet long by 100 feet wide and 28 feet deep. Capacity, 13,000 tons of coal, under water. Coal unloaded from cars and reloaded by means of locomotive crane and grab bucket

Rescreening apparatus for coal

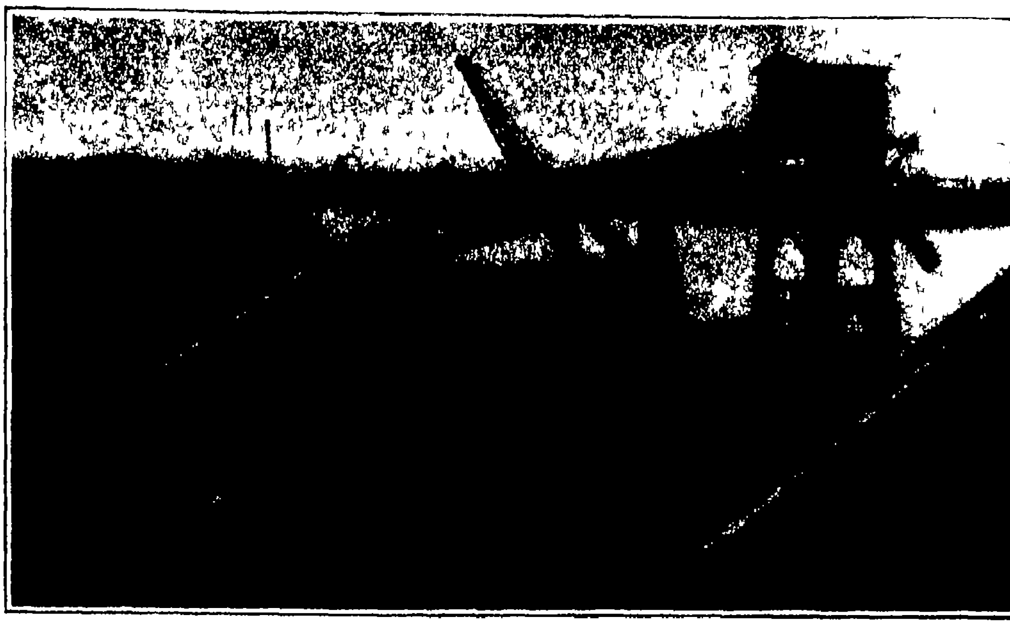
The coal is picked up from the stock piles at the right, in a grab bucket which may be seen on the near side about half-way up the machine. By means of elevators and screens the fine coal and lumps are separated, the fine or slack coal being either loaded into flat cars or piled to one side, as in the picture, and the lump coal loaded in cars for shipment

If the stock piles consist of the larger or domestic sizes, the supply will last for several weeks, or perhaps longer, depending, of course, upon the demand which, in turn, depends upon the weather, but if the stock consists mainly of the smaller or steam sizes, the domestic users will be little benefited. In view of this uncertainty, it is clear that the best way for the consumer and the retailer to prevent a shortage is, before the first of April, to store the coal that he will need.

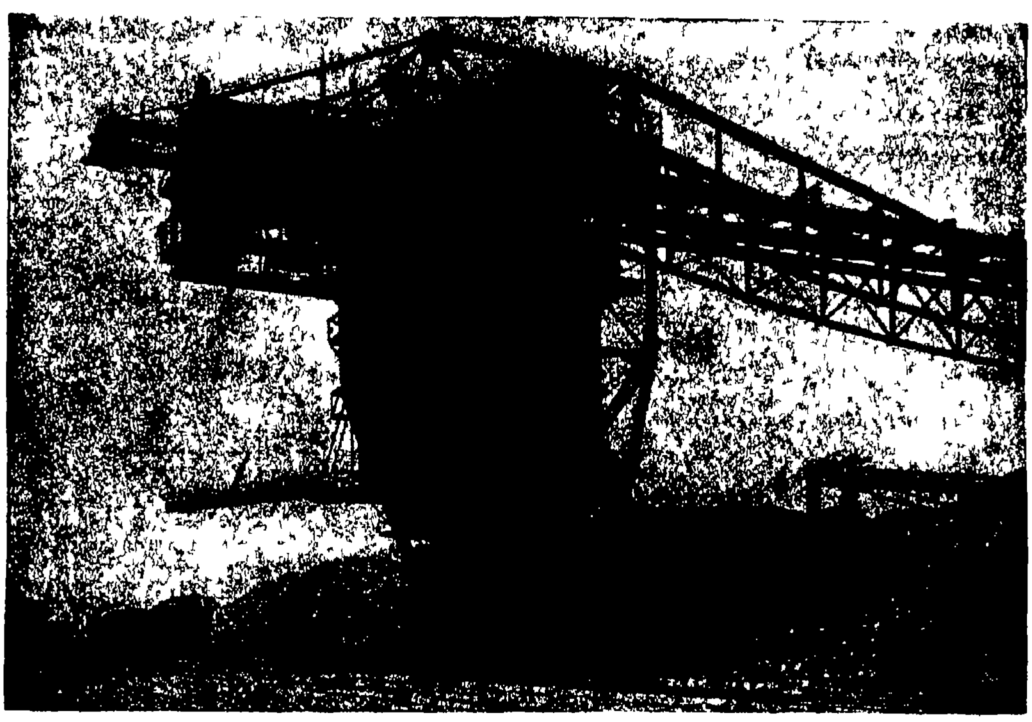
No such stock of soft coal is available. In the event of a suspension of mining in the unionized fields, notably those in Pennsylvania, Ohio, Illinois, Indiana, and the southwestern states, those dependent upon coal from those fields must turn for their supply either to the non-union fields or to their stock piles. Even were the non-union fields (in West Virginia, Virginia, Kentucky, Alabama, and the far west) able to produce sufficient coal to meet the demand—which they are not—the railroads tributary would not be able to move the coal to all sections because of lack of cars and locomotives. It is true that a great quantity of both soft and hard coal is in storage at the upper end of the Great Lakes, at Duluth and Superior, and adjacent points, a quantity probably between 6,000,000 and 7,000,000 tons, but this coal is regularly stocked at those points and is required to supply the normal consumption in the northwest, that is, from Minnesota, west to Nebraska.

For his own protection the consumer, large or small, should, then, have a stock of coal with which to tide over times of shortage, whether due to labor troubles or labor shortage at the mines, or to inability of the railroads to deliver because of lack of equipment, or by reason of severe weather conditions.

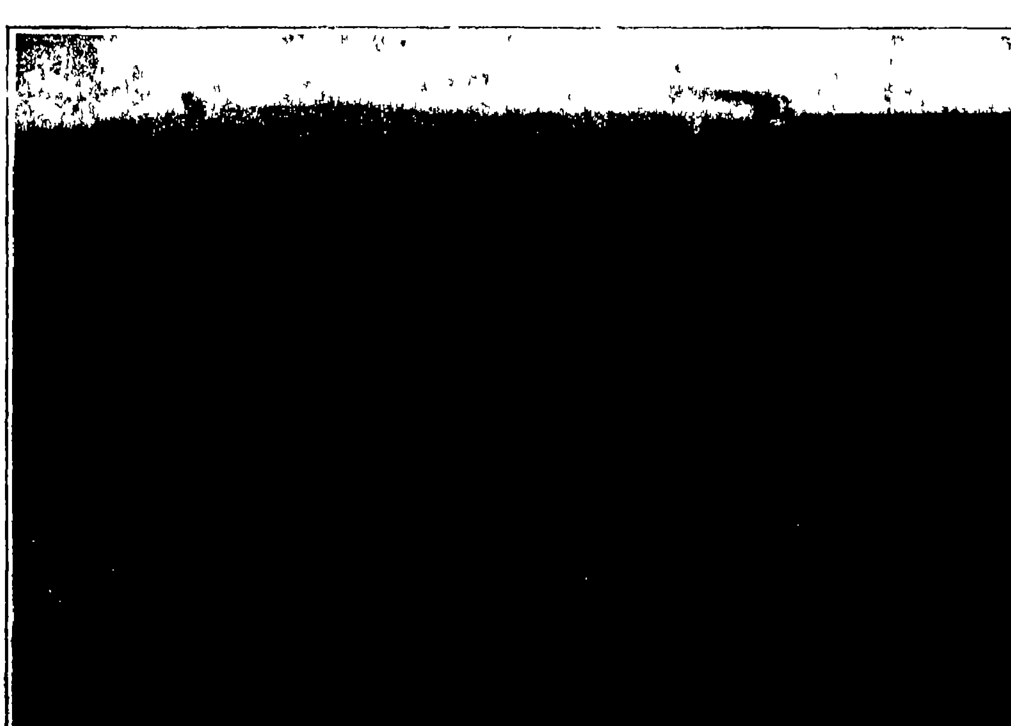
The economical storage of coal, even on a comparatively small scale, except, perhaps, in dwellings, requires a certain amount of equipment and involves a financial outlay. The particular method to be adopted depends to a certain extent upon the kind of coal. Anthracite does not take fire from spontaneous combustion and can, therefore, be heaped to any height desired, and it does not crumble or break up seriously in handling, as does most bituminous coal. The conical-pile method in general use in the hard-coal region is probably the cheapest system of open air storage. On the upper Great Lakes docks both anthracite and bituminous are stored in quantity every winter, in long, narrow heaps. The coal is put into these heaps and taken from them by means of clam-shell buckets suspended from overhead cranes, which, in turn, form a part of traveling bridges of the types shown in the accompanying illustrations. The coal for the Great Lakes trade is delivered to the lower lake ports, such as Buffalo, Erie, and Cleveland, by rail from Ohio, Pennsylvania, West Virginia and eastern Kentucky. It is dumped into cargo boats and transported to the upper end of the lakes, either to Chicago and Milwaukee or Duluth and Superior. This movement takes place, of course, in the summer, during the open season of navigation. From the boat the coal goes into storage piles to wait the winter demand in the northwest, to supply which another shipment by rail is necessary. Before being put into cars for the last time the soft coal is carefully screened and sized to eliminate the fines caused by numerous rehandlings.



Temporary storage yard at Savannah, Ga. Coal is transferred from the cars at the left by means of a belt conveyor and dumped directly into boats



Temporary storage piles of coal to meet an emergency are often of this kind. The small locomotive crane and grab bucket unloads the cars and piles the coal. When the coal is wanted, the process is reversed



Vast quantity of coal at Lambert's Point yards of the Norfolk and Western Railroad awaiting the arrival of coal vessels

The simplest, and incidentally the most expensive way of storing coal is in railroad cars. The accompanying illustration shows Lambert's Point Pier yards of the Norfolk & Western Railroad, at Norfolk, Va., well stocked with coal. This coal, which is in the yards awaiting the arrival of vessels into which it will be dumped over the unloading piers, is really in transit and cannot properly be called "storage coal."

One of the commonest methods of building up storage is by means of dumping from temporary wooden trestles. Long narrow piles are thus made, varying from a few feet to 20 or 30 feet in height. The coal is recovered from these storage heaps either by hand shoveling or by mechanical means, such as steam shovels, grab buckets or locomotive cranes. This is usually termed "emergency storage," and is frequently resorted to by the railroads. It is also in common use at retail yards and by small industrial plants. A large percentage of coal that is now or will be laid by to insure a supply, next April, will be handled in this way. The first cost of such a plant is small, but the operating cost is high, ranging (according to figures compiled by the International Railway Fuel Association) from 10 to 30 cents, or over, per ton. Better laid out and equipped plants, such as shown in the accompanying illustrations, the first cost of which, according to the same authority, may vary from less than a dollar to several dollars per ton of storage capacity, are said to unload and load coal in quantity for five cents or less per ton. Interest and depreciation on the plant, and interest on the money invested in the stored coal are to be added to the operating costs, of course, to arrive at the total cost of storage. The figures will vary greatly with conditions, but at most the cost can be considered a cheap insurance against shortage. Large corporations, such as the companies which

(Concluded on page 229)

Strategic Moves of the War, February 18th, 1916

By Our Military Expert

ABOUT everything that has been written regarding the strategic movements of the war has been solely based on the assumption that the allied lines—and properly, so far—have existed purely on the defensive, the viewpoint of the observer has been of this character and, in all probability, will so continue for some time, or until such time as developments permit a shift of activity to within the territory of Teutonia, if it ever comes.

Examination of the map of the territory before and behind the western line suggests very strongly that Germany's ideas as to her military integrity were concerned solely with the offensive the location of fortified points is significant, for there exists no such chain of permanent fortifications as France has been compelled to build but instead, simply enormous intrenched camps covered by strong works, behind which an army of invasion may mobilize and from which it may thrust.

The location of the contending lines to-day shows clearly how the first thrust was delivered—a gigantic pivot on Metz to chop down through Luxemburg, Belgium and northern France, directly against the heart of the land, Paris. Below Metz, now covered by the famous Verdun St Mihiel Pont à Mousson salient, the line practically parallels the frontier between France, Lorraine and Alsace without much sway one way or another. And the natural geographical frontier that Germany secured as a fruit of the Franco-German war has stood her in good stead. It is a fact that there are no permanent defenses of forts along the line of the Vosges, not even at the passes, the reliance of the German General Staff having been placed so securely upon assumption of the offensive that the natural strength of the mountain was considered sufficient for mere holding purposes.

The opposing lines, of course, front each other in this section as immovably as on the lines farther north, yet no great offensive in the section between the great salient and Belfort has been attempted by Germany, for she is merely holding on there.

Germany's real line of defense lies along the Rhine which in the southern section is closer to the Entente lines than at any other point. The great fortresses of Metz and Strassburg cover the flanks of the lower sector of defense, and the way for a speedy shift of forces has been prepared by the construction of railway lines on both sides of the Rhine, and it is further backed by the inhospitality to invasion of the Schwarzwald, the Black Forest section, with its forbidding terrain.

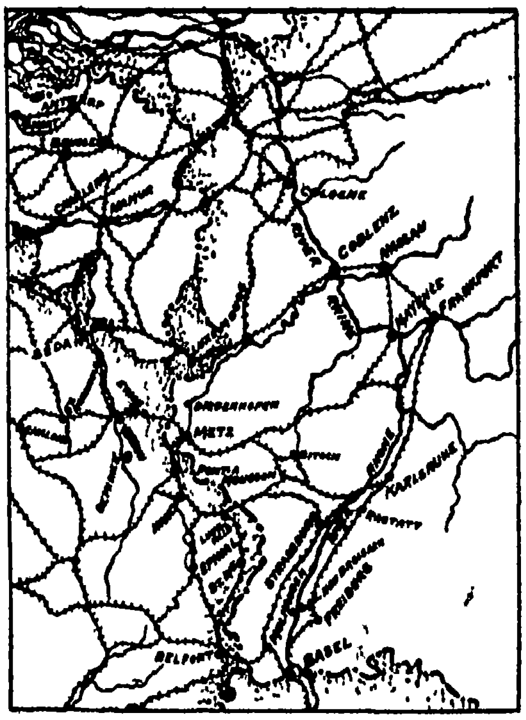
Behind Metz and Strassburg are the great railroads for concentration and supply of field forces.

It is not inconceivable that the fortunes of war may so change that strategic necessity, such as the crushing in one or both sides of the salient formed by the northern part of the line, or the necessity for shortening the line through a falling off of man-power, may some time dictate the wisdom of a general Teutonic retirement to the Rhine. The possibility now seems remote—but it is by no means out of the question. But if this is ever done the war will seem to have started all over again, with Germany intrenched on a line shortened by something like 175 miles at a saving of between five hundred thousand and a million men with the great river itself as a definite barrier to further allied advance, one that must be forced at a tremendous cost and a line that is secured by fortified points, with the most monumental defenses that military science has been able to devise.

These powerful places begin at Strassburg, extend through Mayence, Coblenz and Cologne and are supplemented here and there by lesser works of strength. These points are examples of fortified camps, as Germany depends upon the mobility of her forces for real defense instead of mere fortifications which to her are but points of support. Neu Breisach Rastatt Bitsch and Diedenhofen, though are fortresses which find their greatest utility as barriers on inviting roadways.

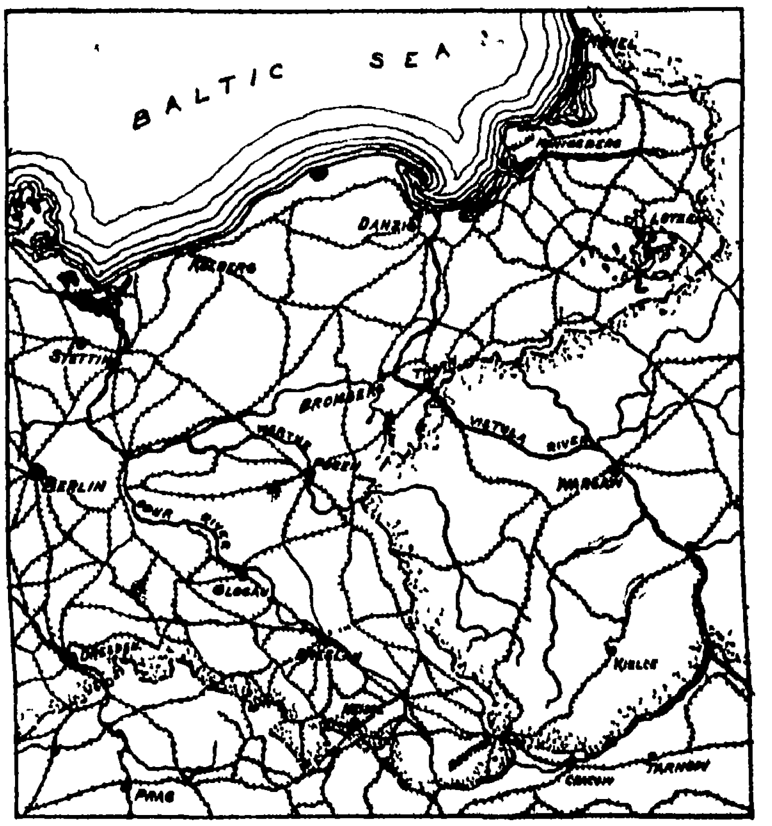
The Rhine fortifications are each located at strategic points, on or near rivers which they control. Cologne is the key to Rhenish Prussia and the great railway system that radiates in all directions. Coblenz controls the confluence of the Moselle and the Rhine. Mayence covers the Main, while the lower fortresses guard a portion of Germany that is essential for the supply of munitions of war.

Both banks of the Rhine are equipped with military railways that extend from the Swiss frontier to that of Holland with at least fifty lines of railway touching the eastern bank of the river, for supply and speedy disposition of men. In turn, this Rhine railway is backed by many others paralleling the front—and each one has been built with military utility overshadowing commercial use, the country has been developed commercially to fit the railway system, not the reverse.



Germany's defenses in the west

Cologne and the neutral territory of Holland cover the great gun works at Essen, which, in itself, is behind the barrier of the Rhine, necessitating exposure of a flank to attack from the interior of Germany should an enemy succeed in penetrating far enough to begin operations against this depot Krupp, for neutral Holland cannot be used as an avenue of advance.



Germany's defenses against Russian invasion

When the Russian "Steam Roller" was launched in the first days of the war, it seemed as though it should be a comparatively easy matter for a powerful force to strike through toward Berlin, for the Russian frontier seems to lie close to Berlin. But the geography of the country, of the frontier, is all in favor of the Kaiser, as an advance through the southern finger of eastern Germany, with a length of line which such a movement would demand, is instantly menaced on the flank by the northern extension of Germany, that section almost tipped by the lake region where von Hindenburg leaped upon the Russian hosts.

To begin with, the eastern frontier is merely an arbitrary one, unmarked by any natural features, the real frontier should be, for Russia's benefit, the line of the Vistula, from Danzig, through Thorn fortress, to Warsaw, then south to Przemysl and on to Czernowitz, along the Dniester. Should the result of the war permit, Russia would be a material gainer by exchanging that part of Poland west of Warsaw for the portion of East Prussia east of the Vistula, it might even be a handicap to her were she to merely take territory without insisting on the exchange.

So the Russian threat against Berlin is not nearly so great as might seem at first glance. This frontier is also defended. A tremendous intrenched camp lies at Danzig, covering, with its companion stronghold farther south, Thorn, the curtain of the Vistula, the intervening crossings of the river being held by powerful bridgeheads, with a system of railway communications existing as excellent as that on the other front, the railway crossings of the river guarded by the fortresses of Gaudenz and Dirschau.

Konigsberg, a powerful fortress at the mouth of the Pregle, supplemented by Memel and Pillau, extends protection to East Prussia. The fortress of Boyen, near Lotzen in the lake region, covers the eastern arm of Germany from an advance by the south, its defense amplified and strengthened by the character of the country, forbidding to an invader, yet easily susceptible of defense.

Farther south, the German line of defense is covered by miles of marshes that are only practicable to an invader when the rigors of winter have frozen every thing hard, in the gaps between such sections, fortresses bar the way. Bromberg backs up the defenses of Thorn and covers the railway leading across the Netze, while powerful Posen is astride the valley of the Warthe.

On the Oder, Glogau interposes between an invader and a tempting road to Berlin, while the intrenched camp of Neisse covers the flank.

But as ever, Germany's principal reliance is in her wonderful railway system. It has been said that during the first year of the war whole army corps, intact, were shuttled across Germany time and again, fifty thousand men, in less than forty-eight hours. When the accompanying artillery, horses, supplies, munitions and transportation are taken into account, it seems almost unbelievable that such an amount of freight, living or dead, could be handled as a body, yet the story of Germany's shifts of force has been proved too often to doubt.

There is practically no change on either line at the moment of writing this article, local activities have occurred, resulting in the occupation of Usciesko by the Russian forces in Bukowina, rendering the security of Czernowitz less sure to Teutonia. On the western line the efforts of Germany to better her position against an expected drive continue, with the loss of a few French trenches in places, offset by gains in others.

Celluloid Covers for the Laboratory

THE customary glass dust covers used in the laboratories on various instruments are rather large, exceedingly bulky and quite easily broken. To obviate the use of such covers, a professor in one of the western universities has evolved the idea of using transparent celluloid for the protectors.

These covers have the advantage over those of glass because they are light, they take up much less room because they may be bent to almost any shape, the cost is moderate, and finally they cannot be broken.

The celluloid may be purchased at nearly every stationery store in sheets of any size. The pattern of the cover is traced on the sheet. After the sheet is cut out, holes are punched at intervals around the edges and small eyelets fastened therein. The cover may then be closed by the insertion of a number of common paper fasteners.

Remarkable Art Casting by a New Process

Faithful Reproduction of Sculptured Objects and Plant Life Now Realized in Bronze, Silver, Copper and Other Metals

By Robert G Skerritt

THE founder has told the sculptor here, time after time, that he must make changes in his model if he wished it cast in metal An swered that the old masters did so-and-so, the man of trade and patented processes has uniformly retorted "Oh, yes, but that is one of the 'lost arts,' and we cannot do those things to-day"

Alfred Lenz, a New York sculptor, has recently demonstrated that the art of the old masters is not a lost one, at least not all lost, and he has proved in the most practical way that objects of great delicacy of form can be reproduced in metal with an astonishing nicety of detail. By way of evidence, he has exhibited floral pieces in bronze, silver and copper made from living models, and his metals have been caused to flow through channels of extremely small dimensions, and then to branch out at the terminal cavities forming perfect replicas in every particular

For instance, one of the examples of his combined skill and method is the clustered bloom of the milkweed. Fifty-six separate thin stems radiate from a single parent stalk that is, in itself of modest size, and at the end of each tiny arm there is a perfect blossom in bronze. Not quite so good from the botanist's standpoint, but yet more remarkable as a technical achievement than the foregoing is the bloom of the wild carrot cast in Dawson copper Here Mr Lenz has succeeded in getting some exquisite results in many of the terminal blossoms—any one of which would be declared impossible by the best of the professional art founders. The crinkled leaf of Scotch kale has also offered a splendid test for this new found method of molding, and becomes an object of art when perpetuated in bronze With equal facility the complex modeling of rare orchids has been reproduced faithfully in bronze and silver

But Mr Lenz looks upon these floral pieces as mere incidents in the testing of his process designed primarily to enable him to reproduce in metal the utmost freedom of design. In short, to permit the sculptor to be untrammeled by the limitations imposed by the art founder who, in his turn, is restricted by the more or less complex apparatus which he employs. Not only can Mr Lenz exercise the utmost liberty in modeling but he is able to cast in metal directly from his original wax "sketch" This makes for spontaneity, grace, and beauty of texture in the metal reproduction.

Heretofore the sculptor has been obliged to make a gelatine mold from his "sketch," and, after removing it from the original model, he has then to cast in that flexible mold a replica in harder wax This second wax model is not plastic like the "sketch" and it is difficult to work away any surface inequalities that may appear It is this model that is used by the founder Mr Lenz does away with this duplication of work and, as a result, saves time and expense, and, what is still more important to the artist, makes practically a reproduction of the "sketch" in all of its original charm and just as it came from the inspired fingers of its creator—obviously, a great step forward in the art.

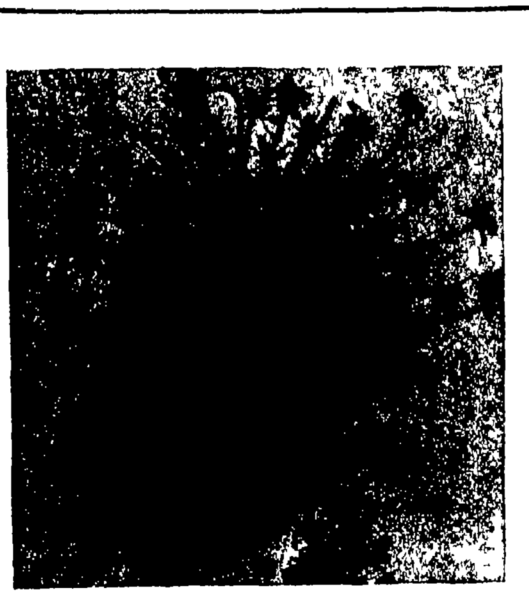
The principal reason for his success lies in the character of the materials which Mr Lenz uses for his molds This is a mixture of earths that he has discovered only after a great deal of experimenting, and he freely admits his debt to the peoples formerly occupying the Americas of to-day Samples of their work now extant show that the artist of the centuries long gone had the cunning needful to give his metals wonderful fluidity and knew the sort of material to use for his mold, which would permit him to reproduce lines of beauty and any delicacy of design With the gold and silver and copper relics of those far-off times have come down to us tell tale mixtures of earths and from these Mr Lenz has obtained a clue which has made his own striking results possible More than that because of the nature of his mold mixture he is not at all hampered by proportions but says that he can cast objects of any size This is a great advance in the art

The molding mixture is so fine that it envelops the model intimately and every line and contour leaves its impress when the investment is dried and the waxen figure is melted out After being heated moderately so as to expel all traces of moisture the mold is ready to receive the molten metal, and because of the non conductive character of the earths used this envelope saps so little of the heat from the fluid metal that the latter flows freely through the narrowest of passages and keeps on moving until it has filled up outlying larger cavities as illustrated so beautifully by some of the floral pieces

In most modern processes the figure desired is only a small part of the total weight of the casting This is because numerous 'feeders' are required to carry the metal to every part of the mold and these branches must later be cut away from the central castings and the points of contact obliterated carefully and patiently In the cases of the statuettes illustrated and the flowers shown but little metal in excess of that visible was needed and only trifling work has been required at a single point of exit to remove the metal that filled the small cavity through which the wax of the original 'sketch' was allowed to escape

There is quite as much of art as there is of craft in Mr Lenz's method and while the fundamental secret of his success lies in the formation of his mold still a considerable part of his remarkable achievements is due to the condition of his metal just before teeming as well as the way in which he actually pours it into his mold In the case of the floral pieces, the flowers or foliage are pickled This destroys the woody fibre and gives the plant a leathery consistency that adds to its stability of form When this has been surrounded by the earthy packing of the mold, and the latter is dried out then heat enough is applied to decompose the vegetable matter and it is expelled in the form of a gas How completely this dissolution is effected is made clear by the character of the metal castings.

Various specimens of plant life reproduced in metal by a new casting process



Above: Clustered bloom of the milkweed reproduced in bronze Note the remarkable faithfulness of the reproduction, even to the minutest details On either side Two statues in metal made by the new process. Practically no finishing has been done on these statues; they appear in the form in which they left the mold.

The International Catalogue of Scientific Literature

THE Smithsonian Institution reports that the European war has interfered seriously with the work and the finances of the International Catalogue of Scientific Literature In normal times this enterprise was generally in a rather precarious financial condition, and just before the war the receipts and expenditures of the London Central Bureau just balanced Subscriptions amounting to nearly $6,000 a year due from five of the belligerent countries have been either delayed or stopped by the war The Royal Society has made a grant to make up most of this deficit for the first year of the war but additional funds now appear to be urgently needed It is to be hoped that American institutions and individuals will do their share toward tiding over the difficulties of this extremely useful and important undertaking

THE FRANKLIN CAR

Simplicity and Results versus *an Eyefull of Motor Mechanism*

JOHN TIMBS, the historian of American invention, says that the history of every mechanical development has been from crude directness at the start to extreme and burdensome complexity—then to a *finished simplicity* that makes the complex stage seem absurd.

* * *

Fulton's Steamboat had a single cast-iron cylinder and one piston.

Marine driving power was at the stage of enormous quadruple expansion engines when Parsons invented the Steam Turbine in 1884.

In Belfast, Ireland, in 1897, was invented a new type of *turbine fan for moving air.*

This application of the *turbine principle to the rotary fan*, moving vastly larger bodies of air than was ever before possible, has in less than a generation set many lines of invention forward fifty years and has all but *revolutionized* certain well-known industries.

It is this principle that is behind the *Franklin System of Direct-Air-Cooling—the biggest step ever taken in the simplification of the Motor Car.*

* * *

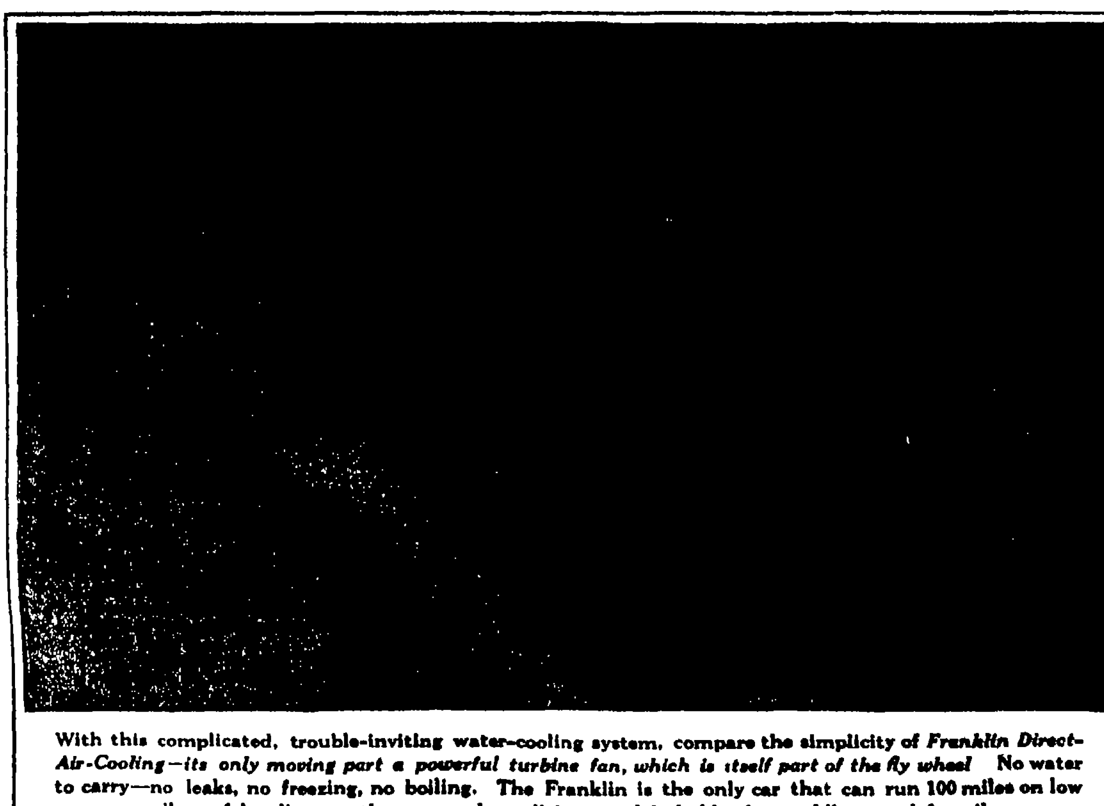
Think of it! Here is an engine with *no water* to carry, none of the annoyances that go with water—freed of the 177 parts of the complicated water-cooling system.

If you want a clear idea of just what it means to get rid of these 177 water-cooling parts, step into a repair shop. Look at the honey-comb radiator, with its 5000 cells, its pipes, pump, connections—a complex system of small-bore water passages, inviting trouble from leaks, from mud and sediment, from freezing and boiling.

* * *

Look at the Franklin Engine! The *only moving part* in the Direct-Air-Cooling System is the air-suction fan, and *that fan is itself part of the fly wheel.*

Nothing to get loose, nothing to break down, nothing to oil, nothing to adjust, nothing to replace.



With this complicated, trouble-inviting water-cooling system, compare the simplicity of *Franklin Direct-Air-Cooling—its only moving part a powerful turbine fan, which is itself part of the fly wheel* No water to carry—no leaks, no freezing, no boiling. The Franklin is the only car that can run 100 miles on low gear, regardless of locality, weather or road conditions, and it holds the world's record for oil economy —1046 miles on a gallon of oil

Touring Car—$1950 F O B Syracuse N Y.
Actual Scale Weight, 2080 P[illegible]d

FRANKLIN AUTOMOBILE COMPANY, SYRACUSE, N. Y.

THE FRANKLIN CAR

The Most Advanced Type of Motor Construction in the Automobile World

Inspect the Franklin chassis! Notice the freedom from all torque rods and reach rods. Notice the one-piece fastening of the full-elliptic springs—eliminating the usual links, pins and other forgings.

No superfluous parts to driving system. The single-unit direct-connected starter does away with the gears on the fly wheel and the attendant shifting mechanism.

The transmission foot-brake does away with fifty per cent. of the usual rods, rod ends and pins.

* * *

Consider for a moment what such simplicity means in the life of the car, in the ease of control, the saving of time, trouble and upkeep expense.

It is the *mechanical complexity* of the average car that drives its *upkeep cost so unreasonably high.*

Nobody knows this fact better than the Used Car Dealer, who is confronted every day with the problem of selling cars with too much machinery.

The motorist who takes *efficiency* as his measure of value, rather than quantity of mechanism, should know the *Franklin Car*—the most *advanced type of motor construction* in the automobile world.

* * *

The fundamental design of the Franklin is so far in advance that the earliest Franklin Cars produced are doing good service today.

The Franklin was the *first four-cylinder car* built in America—and a six-cylinder car when cars in general were still in the four-cylinder stage.

The *Franklin cylinders had valves-in-head thirteen years* before automobile designers in general took them up.

The Franklin was the *first car with the throttle control*—first with the *single intake trunk*—the first to establish *automatic lubrication*—the first to use *full-elliptic springs without reaches*—the first *light-weight* car and the only *flexibly constructed car today.*

It is the policy of the Franklin Company to build a car that will perform a *service* for the *man who owns it* and for the *dealer who sells it.*

* * *

The Franklin is the only car that has averaged *32.8 and 32.1 miles to the gallon of gasoline in two National Tests.* It is the only six-cylinder car that ever went 55 miles on a gallon of gasoline.

It is the car that is absolutely *free from tire troubles*, and delivers its owners an *average of 9630 miles* to the set of tires.

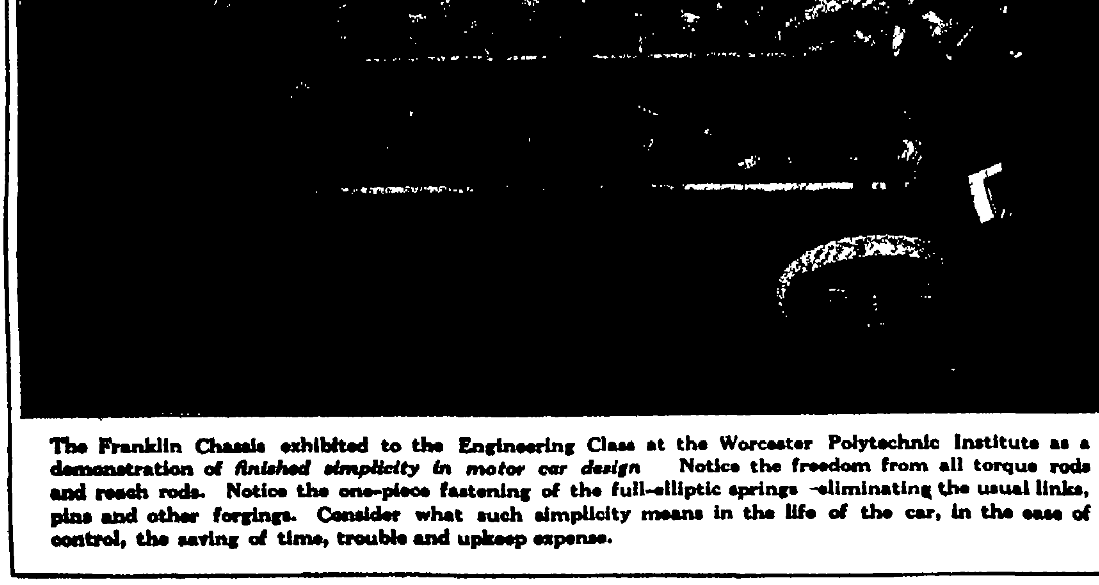
It is the only car that can run *100 miles on low gear*, anywhere, any time.

It is the car that holds the *world's record for oil economy*—1046 miles on a gallon of oil

It is the *only car* men and women, old and young, can *ride in all day without fatigue.*

It costs less to run than the cheapest car made

Performance, service, not "features"—this is the principle of the Franklin Car.



The Franklin Chassis exhibited to the Engineering Class at the Worcester Polytechnic Institute as a demonstration of *finished simplicity in motor car design* Notice the freedom from all torque rods and reach rods. Notice the one-piece fastening of the full-elliptic springs –eliminating the usual links, pins and other forgings. Consider what such simplicity means in the life of the car, in the ease of control, the saving of time, trouble and upkeep expense.

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Industrial Preparedness for Peace

(Concluded from page 220)

It may further be pointed out that in respect to the above raw materials the United States is more independent of outside sources of supply than is any competing nation The American manufacturer is dependent on South America for his supply of nitrates to be used in the manufacture of nitric acid and on Germany for potash to be used in fertilizers Aside from these, no material of import ance is controlled by outside conditions.

The plant necessary to a dyestuff industry can be designed and made in this country During the past few months manufacturers of plants have responded nobly to the calls made upon them for new types and large production. They have been compelled by the stress of circumstances to accomplish things which they never thought they could accomplish Tradition and the fetish of fancied European superiority have been cast to the winds By coöperation between chemical engineers and manufacturers, all types and sizes of plant necessary can be made here

From the physical standpoint then the prospect appears bright. Few difficulties are to be met. Of these, none is insuperable to trained men We can have a dyestuff industry in America if we go at it properly We may be independent of Europe for our colors if this nation as a nation determines that it will be independent To do this, the nation must cast aside all carefully nurtured superstitions of European origin. It must be prepared to be patient All interests must coöperate We must concentrate If these determinations are made and adhered to, then the thing is accomplished.

Coming Restoration of the Mississippi as an Important Artery of Commerce

(Concluded from page 216)

in handling river traffic, is doomed, and boats will be tied alongside the concrete walls where they will be loaded and unloaded by steel cranes and package conveyors Modern machinery has sounded the death knell for the occupation of the roustabout and the bugagoo of present traffic conditions—the cost of shore handling These shore expenses, in the past, have been higher than the actual cost of transportation, and when they are eliminated the river cities will be served by 1,000-ton steel barges of the type now building

An illustration of the possibilities to be found in the use of the river for freight purposes is that of the tow boat "Sprague," which plies between Ohio river points and New Orleans as a coal carrier during the high water season. The "Sprague" can tow 65,000 tons of coal down stream on one trip, and can push 40 empty barges up-stream on the return trip at a fair rate of speed Despite the fact that the "Sprague" is only available for service during the high water season, its owners have found it extremely profitable as a shipping venture

The Inland Navigation company, a $9,000,000 corporation, is building a fleet of 36 1,000-ton steel barges, all to be equipped with wireless and the most modern equipment. These boats require such a light draft that they can traverse the entire 2,000 miles of the waterway at a speed of from eight to fourteen knots an hour during the entire navigation season. One a month can be built in some of the small southern shipyards, so their installation is simply a matter of the completion of the modern terminals needed to make their use a successful venture.

"Mississippi steamboating," Mark Twain wrote, "was born in 1812, at the end of 30 years it had grown to mighty proportions, and in less than 30 years it was dead." The railroads and the tow boats killed the steamboat and, in turn, the lack of improved terminals has killed the tow boat, so that it no longer is used on an extensive scale on the river

"When there used to be 4,000 steam boats and 10,000 acres of coal barges and

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rafts and trading scows," Uncle Mumford, one of Twain's river friends, said, "there wasn't a lantern from St. Paul to New Orleans and the snags were thicker than bristles on a hog's back, and now, when there's three dozen steamboats and nary barges and rafts, the Government has snatched out all of the snags and lit up the shores like Broadway and a boat's as safe as she would be in heaven."

This is why river men believe the time is ripe for the restoration of inland navigation on the Mississippi, for they say, the Government has done its share of the preliminary work.

General Staff Maps

(Concluded from page 221)

sloping is even or whether it changes abruptly and unevenly is not perceivable from such a map.

To improve this Colonel Lehman invented his clever scale. In theory he considered the terrain as a mercatorial plan. Which means a flatly spread country ignoring the fact that the earth is a globe. Since those maps are taken up at the scale of 1 25000 or 1 12500 this involves small sections and the differences are later easily adjusted to the globe system. Next to this Lehman has considered the light as a parallel and not a central light, then he stated that if a perfectly flat surface of a square inch would take off 100 rays of this parallel light, then the same surface would appear white on the map. Now, then, if that surface is elevated at one end, in the eyes of the military map maker, it will get darker for the simple reason that (according to Lehman's theory) a fewer number of light rays will fall on it.

Once this is understood the student of military maps will very easily see the character of the terrain between the contour lines. But to make the degree of elevation directly readable one has to train his eyes to the shades of the slopes. The best maps are those where the scale is expressed by lines. These lines can be easily compared with a specially prepared scale of the degrees.

To show other unevennesses of the ground, special signs are adopted such as ravines, rocks, overhanging walls, etc.

The Military Geographical Institute of Vienna is one of the most completely equipped establishments of its kind. It is a school for officers who possess special ability in these lines and who are commanded to attend this particular study of making and correcting military maps.

Every section is revised at ten year intervals. In wooded countries and where through cutting the forest undergoes important changes, such revisions are made even oftener. Thus the records of the country's terrain are kept as nearly up to date as possible.

The work of procuring foreign maps is not so interesting for the United States. There are no tendencies toward enmity with neighbors, yet, even so good maps are of such valuable aid to the army that no money should be spared to procure them.

The making of maps from the point where the mapping squad receives its three or more triangulation points to start with, points astronomically fixed which are marked and established by the land title institution, to the point of the finished product, is a long and tedious process. It involves all the engineering sciences applied to military needs and all the most improved methods of reproduction and printing involving color processes and lithography.

Preparing to Meet a Coal Shortage

(Concluded from page 228)

furnish electric light and power at Chicago and New York, regularly maintain large stocks of coal. These companies, which use slack and the cheaper grades of coal, have several objects in view in storing, not the least of which is equalizing the cost of their fuel by buying only when prices are low.

It is well known that soft coal is liable to take fire by spontaneous combustion. It was formerly supposed that the sulfur in the coal was in some way responsible for this phenomenon, but it is now gen-

erally understood that what really takes place when coal is exposed to the air is a very slow oxidation or burning, and that if confined, the small amount of heat thus generated accumulates until it is sufficient to ignite the coal It has been found that the danger of spontaneous combustion in open storage can be readily decreased, if not eliminated, by limiting the height of the pile and by having the heaps well ventilated The large storage plants now being constructed at the Panama Canal are designed to hold a total of over half a million tons of coal in exposed piles 20 feet deep At that depth each square foot of storage space will hold half a ton of coal A convenient and ready means for determining when a storage heap is becoming overheated is to drive a small iron rod or pipe into the coal If on removal after being in several hours, the bar is too hot to be held in the bare hand, the coal may be considered near the point of ignition and should be dug out and watered

Storage under water will absolutely prevent spontaneous combustion This method has been installed in a few localities, notably in the middle west, around Chicago, but has not come into general use because of the cost One of the first large plants for submerged storage of coal was built in Illinois by the Western Electric Company, more than eight years ago The coal was dumped from cars on trestles into concrete-lined pits and flooded At the Isthmus of Panama submerged storage is being provided for 150,000 tons of coal

It has been suggested that abandoned rock quarries now full of water are good pits in which to store coal, and the idea appears to be sound The coal could easily be put into and taken from such holes in the ground by means of a locomotive crane and grab bucket Doubtless some of the abandoned quarries at Quincy (near Boston), at Milford (near Worcester), and at East Long Meadow (near Spring field) in Massachusetts, or those at Bedford and Bloomington, Indiana, at Joliet, Illinois, or some of the old slate quarries near Philadelphia, and granite quarries around Baltimore, will be found suitable as regards location to transportation facilities and as regards size and depth to warrant their use as pits for the submerged storage of coal Most of the illustrations in this article appear by courtesy of the Brown Hoisting Machinery Company

Errata

THE articles on The Potash Famine and The American Declaration of Economic Independence which appeared in our issues of February 5th and February 12th, respectively, contained a number of typographical errors. In the diagram at the bottom of page 146, "sixteen thousand lbs.' should read "sixteen hundred lbs" Part of the legend under the diagram was omitted, namely, the explanation that the 'consumption of potash is calculated in pounds per hundred acres of arable land."

In the second article, on page 177, at the middle of the third column, the amounts are given in "millions" instead of 'billions." The text should read, 'The colors for our vast textile industry, with an annual output worth $1,040,000,000, our leather, paper ink, paint and varnish branches, with a total output valued at $1,550,000,000 and scores of minor industries, originated chiefly in Germany The complete list would be of great length ' Near the bottom of this column the reference to the "output of so-called coal tar crudes" should read as follows "The *monthly* output of these products at present is about 12,150 tons (This includes 880 tons of synthetic phenol The 750 tons of benzol required in its preparation should therefore be deducted from the above figure, leaving a net total of 11,400 tons.)" And on page 184, at the end of the first paragraph, "eighteen thousand tons" should be changed to "fifteen thousand tons" as the annual rate of manufacturing artificial colors by twelve American companies.

" * * * * what to him
Are Plato and the swing of Pleiades?
What the long reaches of the peaks of song,
The rift of dawn, the reddening of the rose?"

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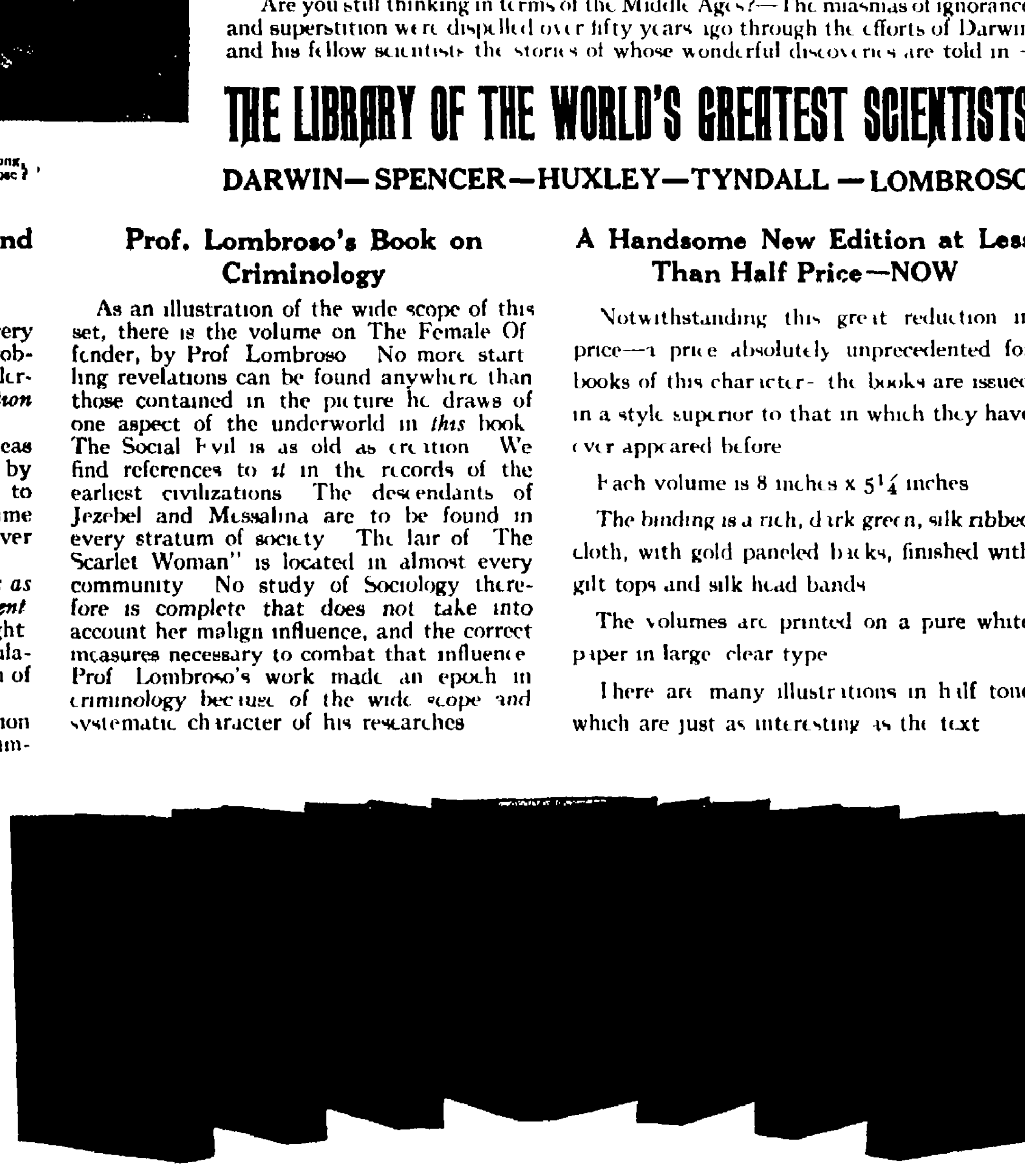

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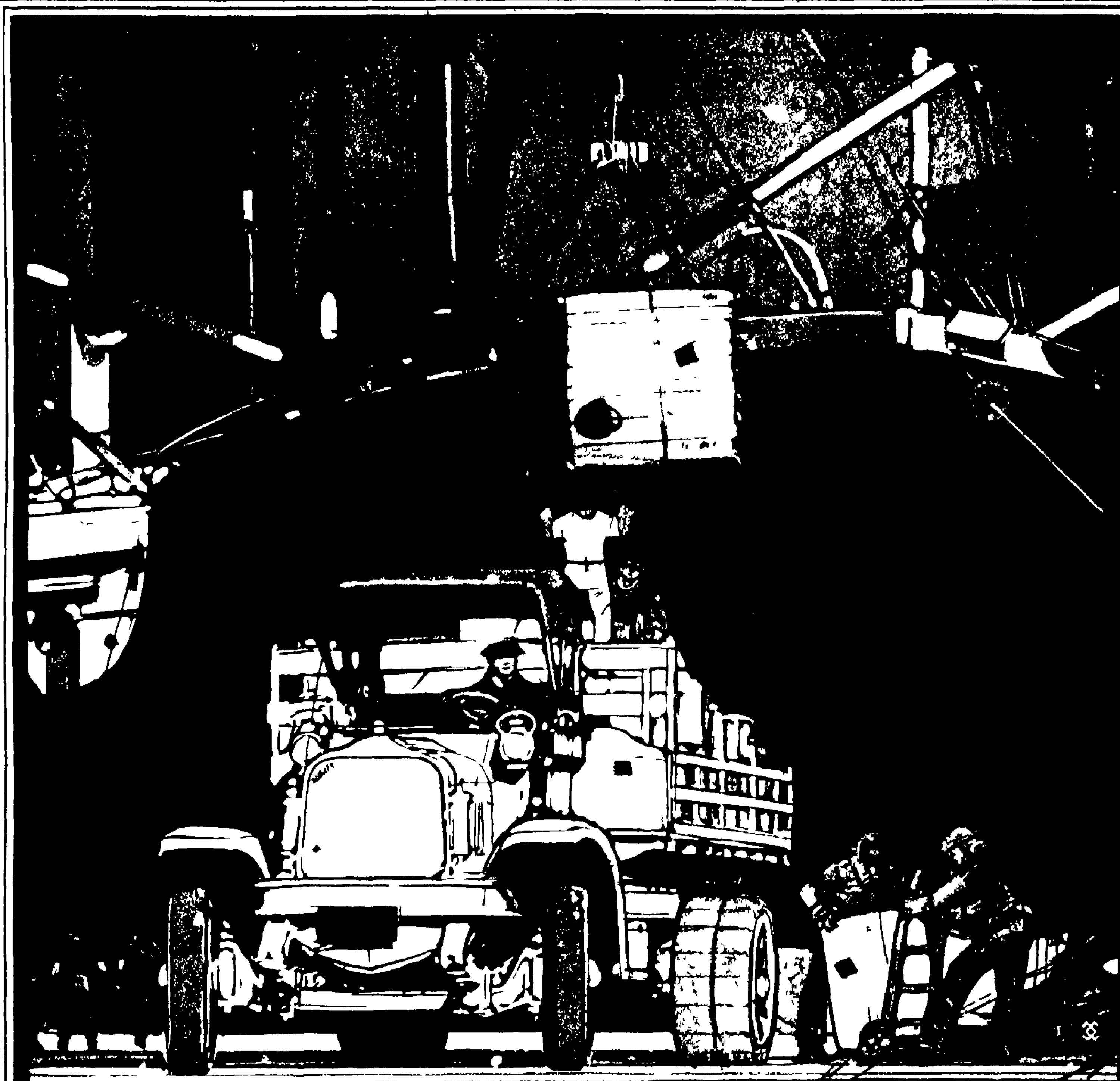

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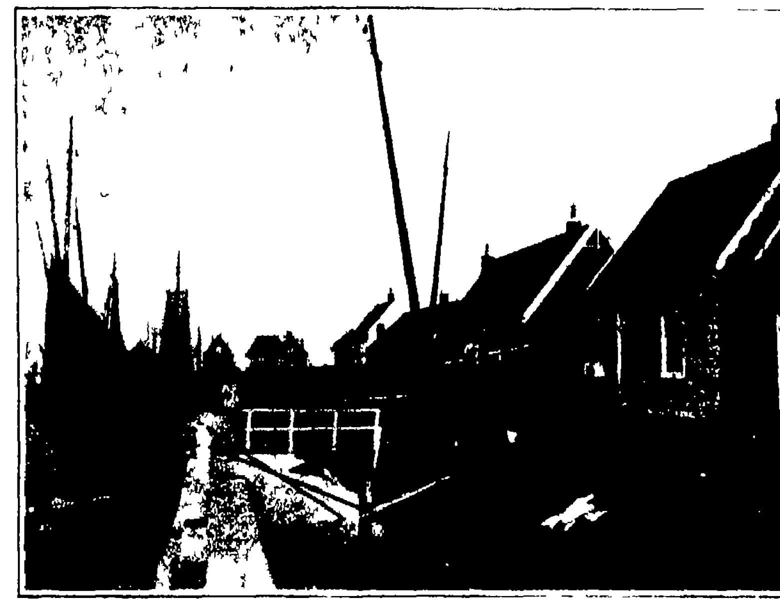
Ruins of a house on the Isle of Marken



A fishing smack driven over the sea wall against a house

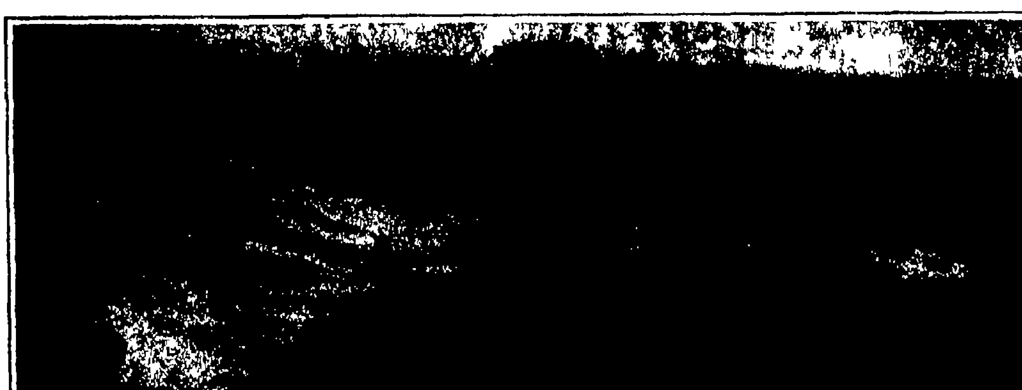
Holland in the Grip of Its Old Enemy

By W J L. Kiehl

THE period of stormy weather in the Netherlands which set in around Christmas and continued with short intermissions of fair conditions until January 20th, was marked by a terrific gale on the night of the 13th and 14th On that night of terror, Holland was invaded by the waters in many places—near Rotterdam in N North Brabant, near Amersfoort and Nykerk, and along the Eem River near Muiden and Naarden, two fortresses and towers belonging to the defenses of Amsterdam, and in the Anna Paulowna polder But the calamity that befell the southern portion of the Province of North Holland is the worst of all—far worse than can be remembered to have ever happened since the fearful St Elizabeth flood in 1421, when 10,000 people were drowned, and it must be entirely placed to the credit of better organization of help better roads, better telegraphic and telephonic communication and railway service, that on this occasion the victims are numbered only by tens instead of by tens of thousands.

After the fierce northwester had driven the waters into the Zuyder Zee until they stretched almost level with the tops of the dykes, the Zuyder Zee broke through at two different points between Vovendam and Monnikendam and southward of the Isle of Marken near Uitdam. The island of Marken itself was entirely submerged; only the "flood-mounds" rising slightly above the waters. The whole fishing fleet and 50 houses were destroyed. The damage is estimated at half-a-million florins for Marken alone. Sixteen persons and perhaps more were drowned, or killed by the falling houses. All the houses in Marken are of timber, some have brick foundations and most all so built that the ground floor is employed for storing goods or as stables for cattle, the top floor being used for dwelling purposes This construction has been taught to the inhabitants to meet the annually recurring floods. But against this dreadful inundation all precautions proved vain Some of the fishing boats were dashed against groups of houses and boats and homes were smashed like so much match wood In this inundation some 12,000 hectares are submerged But more land is threatened and everywhere thousands of the mobilized troops are working with feverish haste with thousands of civilians farmers laborers and others to strengthen the menaced points in the dykes In this way the polders Purmer, Wormer and Beemster up to the present time January 20th have been saved from the inroads of the waters What has happened in the night of the 19th of January I do not yet know, but it was with great apprehension that I heard the shrieking of the storm wind This time however from the southwest All Saturday, Sunday Monday and Tuesday other menaced districts were being gradually evacuated All cattle were driven out or carried away in shallow punts towed by small tug boats At the Tolhuis, an ancient toll bar and hostelry, 20,000 cows were counted as they were brought in There, 4,000 of these animals were milked (they were in sad need of it) fed and sheltered through measures taken by the municipality Later on, they were sent to various "dry" towns and villages or farms where they were billeted on the farmers The municipality of Amsterdam buys all the milk at nine cents a liter and it is then distributed to all the dairies in the neighborhood In this way milk supply of Amsterdam and surrounding districts has been assured But thousands of cattle horses, pigs and fowl perished In one polder it was only possible to save 20 cows out of the 500 it contained Many farmers have lost all they possessed The churches and church yards in the

(Concluded on page 264)



A break in the dyke at Eemnes near Amsterdam

Photographs by Blick & Van Dömer's Uits. Mil.

Temporary repairs on the first dyke that gave way

SCIENTIFIC AMERICAN

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The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Preparedness in the Chemical Industries

AN admirable display of confidence in the ability of American technical workers to provide resources of munitions and other materials of defense in any emergency that may arise in existing relations between the United States and European powers was made by W. L. Saunders, vice-chairman of the Naval Consulting Board, at a joint meeting of chemical societies which was held recently in New York City.

The index of a country's industrial standing as formerly recognized was its consumption of sulfuric acid, the nation that produced and consumed the most of this chemical substance in her arts and industries being accounted the most prosperous, and judged by this standard Great Britain was for a long time reckoned the leading nation of the world. A new and more accurate standard is now employed—a nation's coal consumption per capita, and judged by this standard, the United States with a per capita consumption of five tons stands at the head, outclassing both Great Britain and Germany, who are second in the scale, with an equal consumption of four tons per capita. France stands third, being credited with a consumption of only 1.6 tons, while Russia, with its abounding population and great extent of territory, is away down on the scale of industrial progress, having only one-quarter ton per capita to her credit. These figures are convincing of the fact that the United States has a preponderating advantage over other countries in the strength of its industries, the most important consideration in the question of preparedness for war or peace.

The thing that is lacking in this country is intelligent preparation for an emergency by means of correlation between the various industries and a closer relation with the Government, so that they may know what will be required of them in times of war. If Germany at the outbreak of the European war was able to so mobilize and direct her industries as to overcome the blockade of the British fleet and manufacture from natural resources the basic materials needed for explosives, what may not be expected of the United States under similar conditions? The strength of our country from an industrial standpoint is eloquently attested by its per capita coal consumption, which, as mentioned, exceeds that of any other nation, and all that is needed apparently to raise the efficiency of industrial plants here is to correlate them and bring them in touch with the needs of the Government. Even under existing conditions the production of atmospheric nitrogen in this country and Canada has reached a state where in the event of an emergency the United States could rely as confidently as Germany does on the air for its own supply of nitric acid that would be needed in the production of explosives.

What is true of explosives holds good as regards nearly all other electro-chemical war supplies. As a consequence of the shutting off of supplies from Europe by war conditions a number of important chemical industries have been started in the United States, which, if given adequate encouragement by the Government and the people, will eventually place this country in a position of unassailable economic independence of the rest of the world. The case of magnesium may be instanced. Magnesium is an element of vital necessity in the manufacture of munitions as well as of the machinery employed in military operations. Before the great war all of the magnesium used in the arts and industries in this country was imported from Germany and other countries. Now a full fledged industry is in existence, producing metallic magnesium of a purity that surpasses that of the article formerly purchased from European manufacturers, and the domestic and some foreign demand for American manufactured magnesium is already much in excess of what can be produced at the present time. Magnesium is used in aluminum castings, finding extensive employment in the construction of motor car and aeroplane accessories, though it is most in demand at present for the manufacture of illuminating bombs to make daylight over enemy operations at night-time, and for trailers attached to shrapnel shells, which serve at night to show the effectiveness of the fire.

National preparedness was promoted when the Government took steps to establish the Naval Consulting Board, and, given the right kind of encouragement on the part of Congress, the board should accomplish substantial results in the direction of industrial mobilization for as cogently stated by the vice-chairman of the board, Mr. Saunders, it is far more important, at least in the present stage of the country's defense plans, to have the men in the works organized to know just what to do than to have them in the trenches or in military barracks.

Use of Congressmen's Names for Advertising

IT has been a common practice among certain classes of patent attorneys, conducting their business in Washington, to make use of the names of prominent members of Congress in forwarding the interests of their business. The obtaining of letters of endorsement from members of Congress is a very simple and easy procedure, and anybody possessing a little political influence may obtain such letters of recommendation, and such letters are given almost invariably without any knowledge of the true merits of the case.

There is one well known attorney in Washington who advertises extensively, and publishes a book of endorsements, in which a number of letters from members of Congress are reproduced in fac simile. The book in question is embellished with a frontispiece of a portrait of the well known features of the Speaker of the House. There is nothing to indicate in the letter of endorsement that this gentleman is an inventor or that he has made use professionally of the services of the firm of attorneys whom he recommends. The letters which follow in the same thick pamphlet are equally indefinite on this particular point, and many of them are written in an evasive tone. Nevertheless, upon the incredulous and innocent inventor the publication of such a list of endorsements provides a very imposing certificate of merit.

The use of these methods has carried with it such abuses that an effort is being made to discredit such a system of advertising, and to that end a bill has been introduced in the present Congress to put a stop to this practice. This was one of the first bills introduced into the Senate when it convened in December. We had occasion to refer to it in our issue of January 8th, 1916. The following extract is published verbatim from a report by the Commissioner of Patents to Congress which appears in the Official Gazette of February 15th, 1916. The trenchant criticism of the Commissioner upon the practice of such attorneys needs no comment.

"Last year toward the end of the session a bill was passed by the Senate and failed to pass the House of Representatives, which declared it to be unlawful for any person, firm or corporation practicing before the Patent Office to use the name of any member of either House of Congress or of any officer of the Government to advertise said business. I recommend that a law be enacted in the terms of this bill (S. 7427, 63d Congress, 3d Session). The attorneys who make use of letters from Members of Congress for purposes of advertising are not as a class entitled to be commended to their constituents. A recent investigation showed one concern in Washington which had pending for different applicants 94 applications for patents. This is doubtless an exceptional instance, but it is nevertheless true that these advertisers take applications which conflict without considering the fact that they are representing conflicting interests. They make searches which careful examination will show to be inadequate and inaccurate, and they induce people whose circumstances they do not know to file applications, both in this country and abroad, which no attorney should permit a client to file. In this way they collect hundreds of thousands of dollars every year from people scattered all over the United States and, on the whole, people of the poorer class. The Office never recommends these concerns. I trust the bill referred to may pass."

The Scientific American as a Work of Reference

THE Scientific Library of the United States Patent Office is a vast store house of works of reference. Books and publications in every language form the collection, and the long reading tables are always crowded with visitors who are searching for information which will enable them to act intelligently upon applications for patent. These visitors comprise patent attorneys, inventors, statisticians and patent office examiners and employees. During the office hours the Scientific Library presents a busy scene, a spectacle of activity which to the layman seems hardly commensurate with the somewhat dry and scientific nature of most of the volumes. Here may be found British, French, German, Russian, Austrian, Italian, Swedish, Danish, Belgian, Norwegian, Spanish, Japanese and British Colonial patents, both specifications and drawings running back to an exceeding early date. Indeed the English patent volumes run back to the eighteenth century. These patents are constantly in demand for searching and the item for rebinding books for the Scientific Library is a considerable percentage of the Patent Office budget. This is due, of course, to excessive handling of the volumes.

It has been noted by those who have opportunity for observation that one of the most popular works of reference in the library is the SCIENTIFIC AMERICAN. Bound volumes of this publication occupy one of the alcoves, the series beginning with the issue of September 26th, 1846, and continuing up to date. The SUPPLEMENT is bound separately and occupies a place of its own. No day passes on which both the SCIENTIFIC AMERICAN and SUPPLEMENT are not found on the reading tables. Publication of a description of a device is considered by law an anticipation of invention, and consequently a bar to a patent. For this reason the SCIENTIFIC AMERICAN is also largely consulted by the examiners in the Patent Office. Scarcely one of the forty two examining divisions but has its collection of clippings from this magazine, which are being constantly consulted in connection with applications for patent.

It is interesting to note that the issue of the SCIENTIFIC AMERICAN of September 26th, 1846, referred to above as the earliest issue on file in the Patent Office contains an article entitled "Information to Persons Having Business to Transact at the Patent Office." So it is seen that from the very beginning this paper was relied upon by inventors as a guide to procedure in the matter of obtaining patents.

Two Curious Diseases Recently Noticed by Doctors

ONE of the two curious diseases that have recently come to the attention of the doctors is commonly known as "sleep palsy," but, because it is so often found in those who have been too festive on Saturday night, the hospital name is "Saturday night paralysis." It comes from pressure on that nerve (the musculospiral) which actuates the extensors of the elbow, wrist and fingers. The hard drinker, for whom, on Saturday night, money and leisure inopportunely meet, will often fall forward on the table with his head resting on his arm, and so remain until the effects of drink are over, waking up to find his forearm and hand inert and nerveless, a condition persisting for days or weeks, even months, and similar to that seen in lead palsy.

The other disease is known as "Monday morning paralysis." Fortunately, it is as yet, confined to horses and does not come from over drinking but from food too nutritious or too much food while resting in the stable on Sunday.

The technical name is *Astasia* (gr. a stasis) and it is regarded seriously by horse breeders and ranchers for recovery is rare. In fact, the animal dies in two or three weeks or even as many days.

It seems to be a form of uremic poisoning. The whole system is clogged, the kidneys are inactive, there is breaking down of the blood vessels in the rump. The poor beast presents a pitiful spectacle, he sweats profusely and seems to have absolutely no control of his hind legs.

A Texan rancher recently lost a number of valuable draught horses this way. He tried taking them out for half mile walks, then resting, then walking again; but they all grew weaker and weaker and died.

Notice Concerning the Encyclopedia Americana

SEVERAL years ago we published notices in the SCIENTIFIC AMERICAN stating that the Encyclopedia Americana, published by the "Americana Company" or by the so-called "Scientific American Compiling Department" was not connected in any way with Munn & Company or the SCIENTIFIC AMERICAN. The title "Scientific American Compiling Department" is used without our consent and against our wishes. The company publishing this encyclopedia passed into the hands of a receiver some months ago. A number of sets of the encyclopedia, however, are being offered to the public, through canvassers and in other ways, and we publish this notice with the object of warning intending purchasers that in spite of any representations that may be offered by canvassers and others in connection with the sale of the Encyclopedia Americana, we are not in any way connected with this enterprise. We wish to caution the public against investing in the encyclopedia through any misapprehension of the true facts of the case.

Economic Preparedness

Our Natural Resources and How They Are Being Developed

By Franklin K Lane, Secretary of the Interior

PREPAREDNESS is generally understood as the state of being ready to fight if necessary

But the finest army and the biggest navy in the world cannot constitute real preparedness without the complete mobilization of the industrial resources, which must be behind them Fortunately, such mobilization means profit and development for the country, in the absence of any war or threat of war

Industry and natural resources are strained in time of war from two great causes. It is more difficult to get supplies from abroad, and the demand for what is at hand is supernormal With an increased demand and a possible source of supply cut off, confusion fol lows unless a nation is industrially prepared as to its natural resources to such an extent that an abnormal demand does not throw machinery into disorder

The natural resources of the United States are the most remarkable in the whole world. We have made some mistakes in their development, and private interests have dominated public interests in some cases. But we have seen our mistakes, corrected many of them, and are now correcting others. That this policy will continue, and that nothing will interfere with the development, con servation and proper use of our enormous natural wealth, should be the first aim of all who have real preparedness, either for war or peace, at heart.

Some months since I sought to learn what we had with which to meet the world which was teaching us that war was no longer only between armed forces, but an enduring contest between all the life forces of the contesting parties, their financial strength, their industrial organ ization and adaptability their crop yields, and their mineral resources and that it ultimately comes to a test of the very genius of the peoples involved To mobil ize even a great army is now no more than an idle evidence of a single form of strength if behind this army the na tion is not organized An army is no longer merely so many rifles and men cartridges and horses, but chemists and inventors, mines and farms, automobiles and roads, airships and gasoline, barbed wire and turning lathes, railroads and weather prophets, indeed, the complete machinery of an industrial nation's life

With the exception of one or two minor minerals, the United States produces every mineral needed in industry. We produce 66 per cent of the world's output of petroleum, 60 per cent of its copper, 40 per cent of its coal and iron and 32 per cent of its lead and zinc Tin in small quantities is produced in Alaska and platinum in Oregon, Nevada and Califor nia, manganese in Virginia, Georgia Arkansas and California, but of these latter minerals, as of nickel and some others of less importance, our supply is altogether inadequate for our consumption We can build a battleship, or an automobile (ex cepting the tires), a railroad or a factory, entirely from the products of American mines and forests. To replenish the soil we have phosphorus in abundance, potash is known to exist in the deposits of Searles Lake, California, which, however, is not yet commercially available, and in alunite, where it is combined with aluminum and deposits of which are found in several states; and nitrogen can be extracted from the air by cheap hydro-electric power as is now done in Germany, Norway and elsewhere. So that we can feed the earth and keep it sustained Our soil and climate are so varied that we can produce all the grains, fruits, vegetables and fibers known to the temperate zone, and some found in the semi-tropics. And to crown all these, we have water power that can be made to generate perhaps as much as 60,000,000 horse-power

Our resources are not alone physical. Our ingenuity and ability to design the machine to meet the need have been proven a thousand times, never more convincingly than in a compilation of the most necessary inventions and discoveries which the world uses.

During the past fifty years the people of the United States have given two thirds of the revolutionary, epoch-making inventions of the world, from the telephone and the incandescent lamp to Wright's aeroplane and high speed steel Each day we issue an average of two hundred letters patent to American inventors, and the number of inventions is increasing with the years.

How great a resource this characteristic might be in time of need has been amply demonstrated during the present war in Europe, which has denied us im ports formerly considered essential Benzol and toluol, foundation of aniline dyes and explosives, have been produced from crude petroleum by a new process dis covered by Walter F. Rittman of the Bureau of Mines That an increase in the amount of gasoline which is yielded by crude petroleum is also possible by the Ritt man process is by no means the least of its advan tages.

> THE WHITE HOUSE
> WASHINGTON
>
> February 11, 1916
>
> Sir:
>
> It will be a signal service to our country to arouse it to a knowledge of the great possibilities that are open to it in the markets of the world The door of opportunity swings wide before us Through it we may, if we will, enter into rich fields of endeavor and success. In order to do this we must show an effectiveness in industrial practice which measures up to our best standards We must avail ourselves of all that science can tell us in aid of industry and must use all that education can contribute to train the artisan in the principles and practice of his work. Our industries must be self-reliant and courageous because based upon certain knowledge of their task and because supported by the efforts of citizens in the mills. If scientific research and the educated worker go hand in hand with broad vision in finance and with that keen self-criticism which is the manufacturer's first duty to himself, the fields will be few indeed in which American commerce may not hold, if it chooses, a primary place
>
> Yours very truly,
>
> Woodrow Wilson
>
> The Editor,
> The Scientific American,
> New York City.

A letter from the President of the United States

Barium salts, needed for a variety of purposes, were formerly imported in large quantities, although the raw material, barytes, occurs in extensive deposits in this country We now manufacture these salts in California, Colorado, Illinois, Pennsylvania, New York, Tennessee and West Virginia, the new industry not only meeting the domestic demand, but also furnishing large quantities of barium compounds for export, and we are substituting domestic barytes for the for eign material for all purposes. The substitution of sodium cyanide for potassium cyanide in the treatment of gold ores to the extent of more than half a million pounds in Colorado alone illustrates how the potash shortage is being met throughout the mining states. Tungsten, an absolutely essential constituent in high speed tool steel, is being mined at more points than ever before to meet the special demand in the steel working industry, a tin smelter has been erected to reduce Bolivian ores, cobalt, which is a recent and valuable acquisition to the family of steel alloying metals, is now being produced in quantity sufficient to lower the market price, American antimony is quoted in the metal market for the first time and from Alaska alone more antimony has been shipped this year than was ever before produced from American mines in any one year cadmium formerly imported is now an article of export and in other minor metals full inde pendence of foreign supplies is being worked out Prac tically all the crude platinum from Colombia and part of the New Zealand output is coming to the United States for refining

There is probably no one thing we can do more vital to real preparedness than a comprehensive conserva tion and development of our petroleum resources In spite of the alarmists sta tistics show no immediate prospect of a coal shortage, the total coal produced in a year in the United States is a minute quantity compared to the supply in sight

But of petroleum we have no such com forting statistics How much of it there is in the United States no one knows The Geological Survey has made a maxi mum estimate of twenty three billion barrels which sounds like an inexhaust ible supply But at the rate that it is now being consumed in this country alone (265 000 000 barrels a year) this does not mean an indefinite supply and from the rapid exhaustion of some fields it is manifest that there can be no real approximation of the oil in our lands Whatever the supply it should not be allowed in its crude state to compete with coal as fuel Petroleum is a priceless resource for it can never be replaced Trees can be grown again on the soil from which they have been taken But how can petroleum be produced? It has taken the ages for nature to distill it in her subterranean laboratory We do not even know her process We may find a substitute for it but have not yet It is practically the one lubricant of the world to-day Not a railroad wheel turns without its way being smoothed by it We can make light and heat by hydro-electric power but the great turbines move on bearings that are smothered in petroleum From it we get the quick exploding gas which is to the motor and the airship what air is to the human body To industry agriculture com merce and the pleasures of life petro leum is now essential

Among our natural resources which should be developed as speedily as pos sible to their full capacity as a measure of preparedness for a successful peace or the prosecution of any war into which the future may draw us are our wonder ful water powers Among the strange things done by Benjamin Franklin was to give an added and peculiar value to the ledges of granite which confine our western streams and turn them into dam sites useful for purposes of power gen eration How many of these are on pub lic land not yet disposed of no one knows but we have several hundred under with drawal which should be freed from with drawal and turned into use just as quickly as possible, for, as the muscle of man or horse can raise a few barrels of water from the well to supply stock or irrigate the garden patch, so can the power of the stream turned into electricity, be used to raise millions of barrels of water to irrigate alfalfa farms or orchards And this is now one of the most common uses of electric power in the West, and, in fact, some of the eastern states where irriga tion is found of value Then, too, there is that mystify ing miracle of drawing nitrogen from the air for chemical use, which can be done only with great power, but is being done in Germany, Norway, Sweden, France, Switzerland and elsewhere, by which an in exhaustible substitute for the almost exhausted ni trates of Chile has been found This is already a great industry in Europe, and will of necessity become greater in the United States than elsewhere, because

(Concluded on page 258)

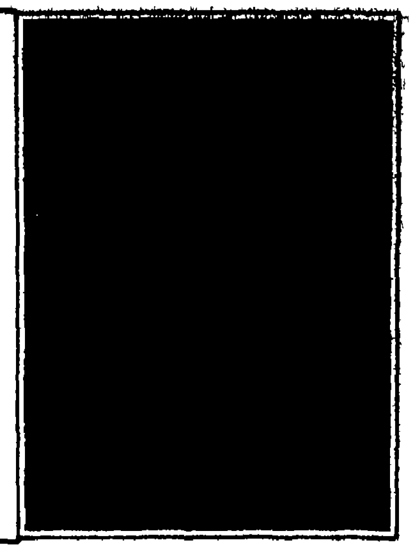
A wartime Garde de Champêtre

Women Workers of France

New Duties that Women Are Assuming to Release Men Needed at the Front

By Martin Wells

THERE is more than a sentimental side to the story of how the women of France—and for that matter the women of every nation engaged in the gigantic conflict—have enlisted their services in the numerous industrial and civic activities heretofore engaged in by men only There is involved the all-important question of labor readjustment after the war And this becomes more serious when it is recalled that women have proved so competent in their new work that already there are rumors to the effect that women will retain certain of their new tasks in post-bellum days —EDITOR.



Woman ticket puncher of Paris

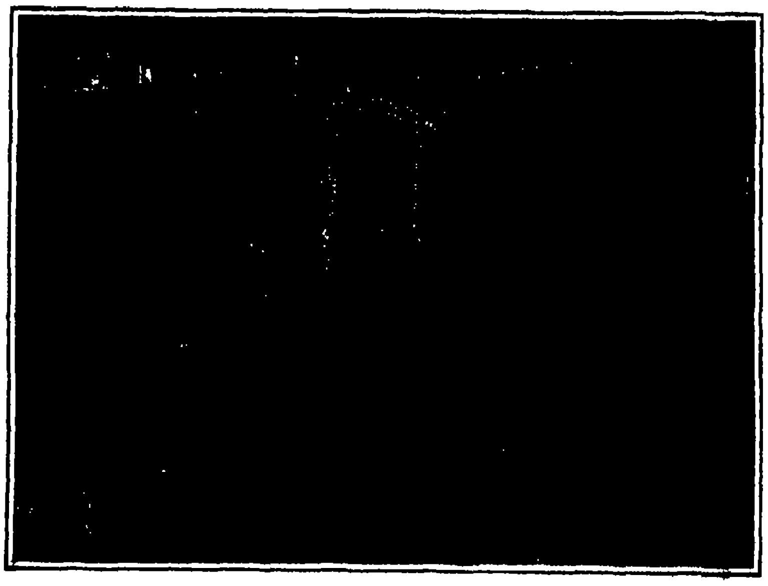
THE response of European womanhood to the necessities of the states engaged in the great war has been so general that abroad it is now taken as a matter of course, exciting little comment in the more vivid interests which, having upset the Continental balance, now center upon the battle fronts Yet, in the travail of conflict has been brought forth an emancipation from the customs of centuries, a visible expression of the national soul through those whose lot it has previously been but to stand and wait, and the women of the warring empires have writ for themselves a page into history which no erosion of time can dim

From Paris in particular, we are told how the wives, mothers, sweethearts and sisters of Frenchmen have rallied to the workshops and humble civic posts, in order that men, otherwise needed in the industrial fabric, might be released to shoulder a rifle or crouch grimly behind the shield of a "Seventy five" under the Tricolor of the Republic

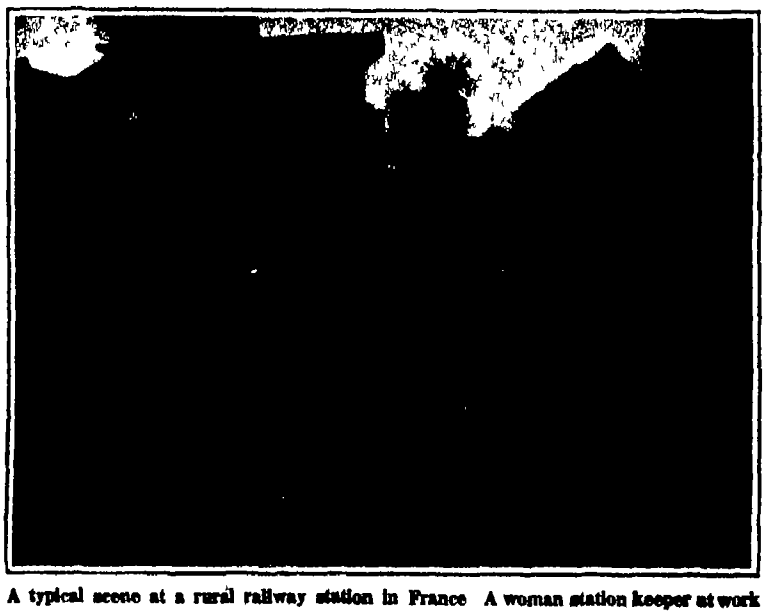
The ravenous maw of battle clamors for incessant feeding Shells, shrapnel, rifles and equipment, clothing tools, hospital supplies and provender—and always more shells—must be forthcoming or the safety of the line will be jeopardized So into the factories devoted to this class of product these women have gone donning coarse aprons or overalls and bending a splendid vitality and intelligence to mastering their proud duties

An examination of the accompanying illustrations will more definitely epitomize the spirit of these women than cold, printed words can The pictures are so obviously unposed, the attitudes so natural, that they convey an impression of reluctance to be interrupted for so trivial and incidental a thing as being photographed

The illustrations depicting women laboring in the shell factory suggest the scope of their activities From the rough casts of shells being turned down to fit the guns to the final placement of fuses, through the various stages of completion, the work is being performed by women



A French woman conductor at work for the street car railways of Paris



A typical scene at a rural railway station in France A woman station keeper at work

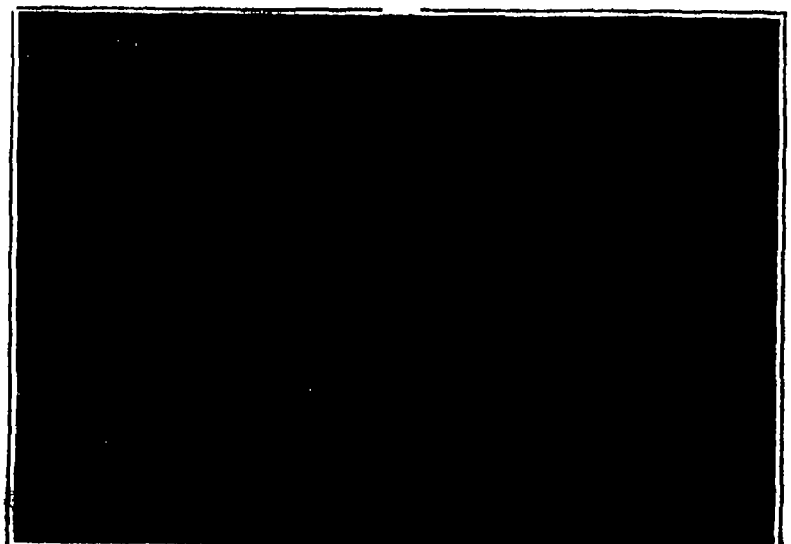
whose brawny hands seem to grasp lever and tool with efficient confidence and ability It is remarkable that in these pictured munition workers no smile is to be seen, they are evidently in earnest with no time for trifling

Among women engaged in the discharge of lesser civic duties are to be found some who perform certain duties of the Garde de Champêtre, such as the old peasant who rolls her drum and voices her announcements as the local town crier did before her At rural railway stations women have taken over many of the posts of former station agents. Some have even mastered the mysteries of the telegraph and are becoming expert manipulators

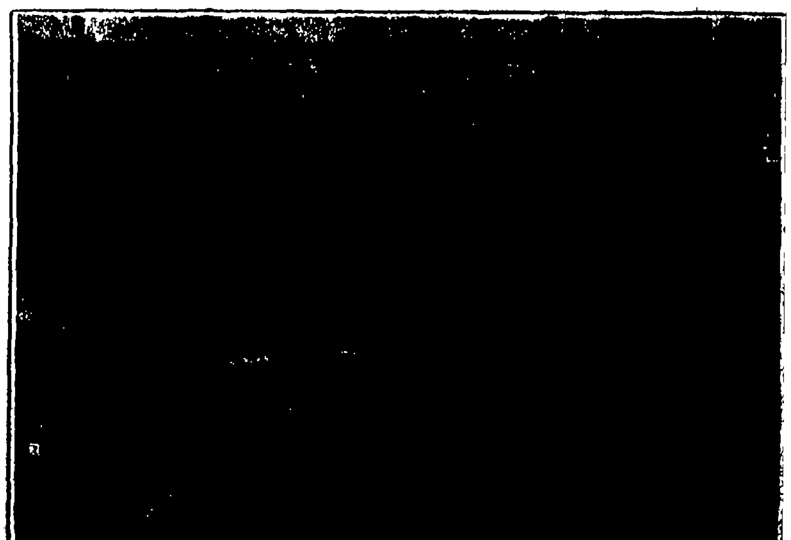
In the Paris subways, ticket controllers —women—stand at the entrances, ably executing their functions and amply equal to any emergencies which may arise through contact with the public. A certain deference is, of course, accorded by chivalrous France to their sex So effectively have they served that, after veterans incapacitated for other occupations have been provided for, a disposition is evidenced to retain women in these duties even after the establishment of future peace.

Trams, omnibuses and public vehicles in French cities have largely been given over to the control of women officials. Such positions as require a certain amount of physical strength beyond mere endurance are not difficult to fill, for the peasantry and so-called lower classes of women are sturdy and have been accustomed to hard labor since childhood.

Dating back to the beginning of hostilities, the old custom of women to work in the fields has been amplified until by far the greater part of the agricultural work is now being performed by them. The plow point sinks as deeply into the soil beneath the guidance of their able hands as it did when their men grasped the handles, and the mowers clatter as effectively as ever Strong, vigorous women, among them the mothers of lusty sons who are with the colors,



Women operatives at work on the lathes, machining rough shell castings



Woman worker turning down the copper rings on shells for field guns

may be seen in the fields pitching bundles of grain high onto traveling ricks, or engaged in any of the various duties of farm and field, even to the swinging of ringing axes and the cording of wood.

Women have almost entirely replaced men in the manifold clerking positions in offices, while the municipal laboratories employ the services of many young women whose education has made possible adequate discharge of their exacting duties.

They clean the streets, bake the bread, curry horses—such few as have not been requisitioned for the service—work in mines, engage in almost every class of manufacture and, as always, devote themselves with tenderness and ability to the care of the sick and wounded There is practically no post that a man may fill, save those on the line of battle, which these Frenchwomen do not occupy efficiently

This volunteering of women suggests strongly an actual unity of public sentiment as to the prosecution of the war and the general resolve to see that the conflict is carried to a satisfactory conclusion, in order that future warfare may be rendered improbable

In France a story, seemingly well authenticated, has been current for a year It is said that when England was about to join the Allies, Germany offered to restore the Lost Provinces to France if she would give guarantee to remain out of the struggle The recovery of Alsace and Lorraine has been dear to the heart of France, the offer was tempting The tale goes that those in authority hesitated, appreciating how much blood and treasure might be saved, yet realizing that it was the right of the French people, particularly the women, to have a voice in the decision, and it was unofficially submitted to them

"No," they replied, according to the story, "while we want Alsace and Lorraine, we are not fighting for them alone. We are fighting for our children and our children's children that war may be abolished for evermore If we must lose our husbands, fathers, sweethearts and brothers, so be it—but let us fight it out at any cost, even that of national destruction"

The story may or may not be true actually, but such a spirit is evident, so there is, after all, little wonder that Frenchwomen have rallied to the state as they have

Verifying the calibre of each shell, using a sensitive but quick-acting gage for the purpose

An important feature of shell inspection Weighing the shells by means of a standard

The Current Supplement

AN important article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No 2096, for March 4, 1916, is *The Longest Railway Tunnel in America*, which describes, with a number of excellent illustrations, a great engineering work being prosecuted in British Columbia An interesting feature of the undertaking is that the mountains are being penetrated by an entirely new method that results in very rapid work *The Importance of Geographical Research* calls attention to the crudeness of many past observations, and makes a plea for more scientific and accurate methods *War Illuminations* describes and illustrates a number of methods employed for illuminating the enemies' lines at night *Torpedo Tubes* gives a popular description of the mechanism by which torpedoes are launched either from the deck of a vessel or from beneath the surface, as by a submarine Illustrations accompany the description Many suggestions have been made in relation to commercial preparedness, in view of the competition that is anticipated after the war *Industrial Militarism* is a valuable addition to this literature, for the writer shows how military preparedness may be made of extreme commercial importance in the individual development that results from systematic training The interesting article on *Evolution in Shipbuilding* is concluded *Signalling Among the Ancients* is an unusually readable historical account of methods of transmitting information mainly of a military character, that have been employed in years gone by *Wood Older Than the Hills* describes and illustrates some interesting specimens of wood discovered in glacial deposits. *Some Remarkable Armadillos* tells of these curious armor bearing mammals of South America some of which are little known There are several excellent illustrations *The Screw Propeller* reviews some fundamental facts in relation to this important adjunct to marine transportation, and treats of its method of action Among other interesting articles in this issue are *The Limitations and Possibilities of Radio Telephony Some Recent Experiments on Pasteurized and Boiled Milk*, and *Our Modern Engineering Education.*

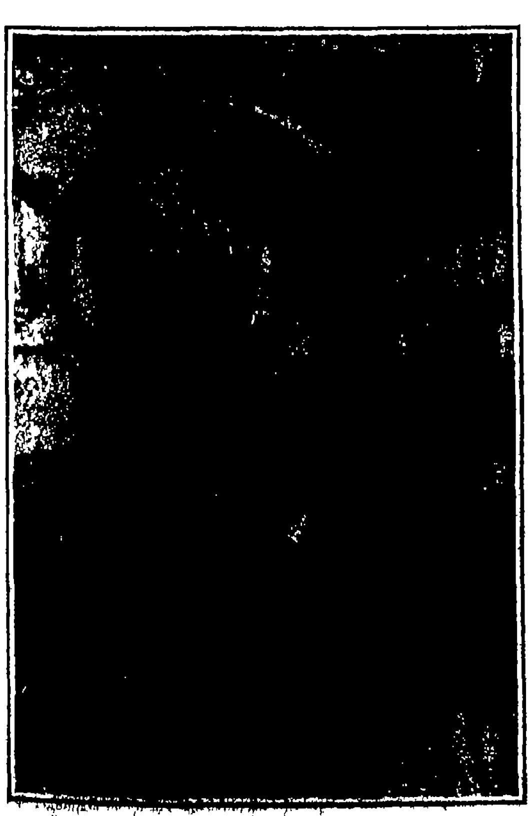
Sir Clements Markham

IN Sir Clements Robert Markham, who died in London January 30th, British geographers lost a leader whose influence has made itself felt for more than half a century The importance of this influence will be evident from the fact that Sir Clements, apart from being a most prolific writer on geographical subjects, was by all odds the most commanding personal factor in the affairs of the Royal Geographical Society, which is, in turn, the most influential geographical organization in the world For twenty five years, from 1863 to 1888, Markham was honorary secretary of this society (the "honorary" being of course merely the British way of denoting the fact that he was unsalaried, but not, for that reason the less hard worked), and on relinquishing this post he received the Founder's Medal of the society in recognition of his services. For the unprecedented period of twelve years, 1893 1905 he was president of the society and from 1905 to 1912 he was one of its vice-presidents

Born in 1830, he served in the Royal Navy from 1844 to 1852, during which period he first acquired his interest destined to be lifelong in polar exploration, through taking part in the Franklin Search Expedition of 1850 51 In 1852 54 he made the first of his visits to Peru A second visit, in 1860 61 was made under the authority of the Secretary of State for India, with a view to collecting specimens of the cinchona plant then grown only in South America and introducing the cultivation of this plant in India His mission was successfully carried out and resulted in an enormous increase in the use of quinine in fever stricken regions where it had previously been a rarity In 1867 68 he served as geographer to the Abyssinian expedition under Lord Napier

Among his numerous and varied geographical activities, Markham's efforts in behalf of arctic and antarctic exploration were perhaps most widely known The arctic expedition of Sir George Nares, fitted out in 1874 was chiefly due to his indomitable energy The same may be said of the National Antarctic Expedition of 1901 04 It is not too much to say that this epoch making expedition would never have left England but for Markham's indefatigable efforts to raise the necessary funds from private sources from the government and from scientific societies Neither, except for Markham would the expedition have been commanded by Captain Scott

Sir Clements was inclined to be obstinate in his opinions and managed to tread on the toes of a good many people including those cisatlantic geographers who have most jealously defended the reputation of the American antarctic explorer Charles Wilkes Markham's contemptuous dismissal of Wilkes's claims in the former's article, "Polar Regions contributed to the ninth edition of the Encyclopædia Britannica, represents the extreme attitude on the British side of an international controversy which did not altogether terminate until the recent Mawson expedition confirmed the general results of Wilkes's explorations, while revealing their many incidental inaccuracies The irrepressible Sir Clements was also credited with some skeptical remarks on the subject of Mr Roosevelt's South American discoveries



Huge punch press forcing copper rings in place on the shells

Tamping down of the charge in the field-gun shells

Industrial Preparedness for Peace

IV. Staff Organization

By Miner Chipman

FIVE HUNDRED MILLION DOLLARS are annually expended by the people of the United States for medicines. At least 80 per cent of this Five Hundred Million Dollars is spent without the advice of a physician. The Panama Canal has cost to date approximately $375,000,000. If 80 per cent of the medicines for which these Five Hundred Million Dollars were spent could be dumped into the three hundred and seventy five million dollar canal we would materially increase the efficiency of the people of the United States, and the canal as a highway of commerce. Think of it! An amount equal to the Anglo-French loan blown in for medicines 80 per cent of which were taken without the advice of a competent physician.

Why this waste?

The answer is found away down deep in the problem of National Efficiency. We lack confidence in Staff. We prefer to let our own staff make a guess—a stab, and let it go at that. It is stated that the average wage earner loses about nine days every year because of sickness. There are approximately 30,000,000 wage-earners in the country. At only two dollars per day the annual wage lost through sickness is approximately $722,000,000. Add to this figure the five hundred million expended for medicines and we have the staggering sum of $1,222,000,000 of which at least 60 per cent is preventable waste. Yet we see many pages of the Congressional Record devoted to a discussion as to whether or not we shall build one, two, or three battleships. I shall not go into a discussion of such National wastes as chewing gum, bon bons, toy dogs, cheap jewelry, etc. This waste of six or seven hundred million dollars for medicine, and lost time in industry is illustrative of a typical American inefficiency.

If there is one drawback to a democratic form of government it is the tendency to regard majorities as more indicative of perfection than individual staff advice. In the long educative process of creating an efficient democracy, the problem of bringing about a recognition of the significance of *Staff Organization*.

The Staff is a kind of aristocracy and even an enlightened democracy will be slow to recognize the aristocracy of Staff trained intelligence. As science takes the place of guess work, the Staff Organization becomes more and more an autocratic aristocracy. Yet science as a contributor to social organization is the most *democratic* thing in the world. As a schoolboy I was often told of my chances to become President of the United States. I have been ready to sell my chance for a nickel for the past twenty years. The average American boy had rather belong to the aristocracy of engineers, chemists, or physicians than hold any political office to be offered in the land. Charles P. Steinmetz is the *Grand Duke* of electrical engineering. In any branch of engineering, a man would rather hold a John Fritz medal than any commission to be offered by the Federal Government.

The one factor of our present social organization the Socialists have failed to account for is the *Staff*. We have had the division of labor and the specialization of industrial occupations and at the same time, we have had the specialization of intellectual occupations and the consequent development of *Staff*. Although Staff represents the ultimate ideal of a perfected democracy—viz. complete knowledge and recognition of the Laws of the Universe socialism tends to discredit Staff and substitute the undivided and unspecialized intelligence of majorities. The Socialist would rule the world by arithmetic and therefore when he finds a condition where one plus one equals one, he is confounded.

The measurement of Staff is not arithmetical. Two engineers do not know twice as much as one engineer. Two physicians will not cure you in half the time required for one. The two physicians may possibly kill you in half the time but that is not a part of our discussion. Staff plus Staff equals Staff and the total is greater than one of the units only to the degree in which one or the other of the factors is greater. Two engineers of identical training and experience, if thrown together upon a problem, do not produce the work of an engineer having twice the engineering ability of either one.

Five Hundred Million Dollars are spent annually for medicines, because we the people do not have adequate confidence in Staff. Most of us look upon the doctor as we do upon the fire department or the police force—to be called in when things look real bad. This vast sum of money is only a drop in the bucket to the sum total of money wasted because we do not recognize and take advantage of competent staff advice.

This wastage is not confined to the naive citizen. Not at all. It is found in the little grocery store, the department store, the small factory and the largest industrial institution. It even extends itself, perhaps naturally so, into the activities of the machinery of the Federal Government. If F. W. Woolworth located his Five and Ten Cent stores with the same degree of intelligence exhibited in the location and construction of post offices throughout the country, but there is no "if" about it—he doesn't. His stores are located upon the basis of staff studies," and there are no log-rolling or pork barrel calculations in it.

The large electric manufacturing companies maintain large and expensive staff organizations. The Rockefeller Foundation for Medical Research is essentially a staff organization. Physicians, surgeons, engineers, chemists and architects—all are staff.

The foundation of staff is technical education. Germany's industrial and military organizations are built upon Line and Staff organization ideals. We marvel at the stories relating the wonderful detail of control to be found in the German General Staff. It sounds new and strange to us because we are unfamiliar with strict obedience to staff principles. Just the other day I read a report where one of the German armies invading Serbia discovered an old copper mine. The commanding officer wired Berlin of his discovery and asked to have timbers, mining tools and equipment and men sent to the spot. He received an answer immediately to the affect that the materials, equipment and men were already at the frontier. The General Staff knew in advance that this mine would be found and what would be needed to operate it. Information that can be obtained in *advance* is procured, the Staff does not wait until something happens.

The Staff plans, the Line executes. This scheme of organization is the underlying principle of scientific management. We wish to build a house. We employ an architect who prepares the plans and specifications to the smallest detail. We then employ a builder who, in our opinion, is best fitted to carry out the plans of the architect. The former is Staff, and the latter is Line.

The processes of paper manufacture require Line and Staff organization for maximum efficiency. Paper making is largely a chemical process. The chemical laboratory should be the center of the planning department of the mill. The Chief of Staff should have under him a corps of staff specialists, as follows:

- (1) Chemists
  - (a) Raw materials
  - (b) Materials in process.
- (2) Machines
  - (a) Capacity
  - (b) Efficiency
- (3) Sequences
  - (a) Routing.
  - (b) Despatching.
- (4) Time
  - (a) Standard time
  - (b) Efficiency

All paper mills without exception, maintain a chemical laboratory. At times the staff service of the laboratory is very inefficient. I have found chemists who did not appreciate the significance of Staff but desires to be in a line position, issue orders, and assume authority. The chemist is usually in very bad odor under these conditions. In other cases I have found chemists who were truly staff, but the line management refused to recognize the staff. In this case the reports of the chemical laboratory were nicely filed away, and line action was not controlled or influenced by the recommendations of the staff. In one large paper mill I found both of of these causes in operation. Much depends upon the personal equation. It required the Prussian type of military genius to develop and enforce Line operation in accordance with Staff planning. Von Moltke had the genius and the power to carry out his ideas of line and staff in military organization. Discipline of the highest order is essential to an efficient organization of this type. Maximum production efficiency can be attained only under such an organization. The functional foreman of scientific management, as developed by the late Dr. Frederick W. Taylor was Staff and Line at the same time. The functional foreman had back of him, however, the purely staff operations of the planning room.

Our program for Industrial Preparedness for Peace must recognize those principles of industrial and commercial organization which contribute toward maximum efficiency. Education, technical and vocational, must be given most hearty support. The so-called Smith-Hughes Bill, providing Federal aid for vocational education in the states is a step in the right direction. This bill has been indorsed by the National Society for the Promotion of Industrial Education and the American Federation of Labor. Vocational education paves the way for an intelligent line organization. In a democracy we cannot hope to enforce a recognition of staff by Prussian methods of discipline, although we might wish to do so. Proper recognition of staff upon the part of the line workers, can only come through an adequate system of industrial education. In the opinion of the writer, industrial education is the first step in real scientific management.

The Government as Staff

The Government at Washington maintain many large and efficient Staff organizations for the benefit of business. I am, at times, surprised to discover how many business men are unfamiliar with the activities of many of these staff departments of the Government. I shall not attempt to describe all of the staff departments now in operation, but desire only to point out a number of them whose service can be of imminent value to the business man.

Bureau of Foreign and Domestic Commerce

This Bureau issues a Daily Commerce Report. In my opinion this publication should be on the desk of every business man, large or small, in the United States. In condensed form you have prepared the story of business conditions throughout the world. Each day there appears a list of Foreign Trade Opportunities. Every businessman who is alive to the opportunities for trade expansion should glance through this report every day in the year. The Daily Commerce Report will be sent to your address, post paid, upon receipt of $2.50 by the Superintendent of Documents, Washington, D. C.

Bureau of Labor Statistics

The Bureau of Labor Statistics issues a series of Bulletins dealing with labor conditions throughout the world, labor laws, court decisions, cost of living, etc. A number of very valuable bulletins have been issued dealing with vocational and industrial education. The bulletins as issued by this bureau form a very valuable library upon labor problems.

The Bureau of the Census, the Child Welfare Bureau, the Commissioner of Education and other departments issue bulletins and other publications upon subjects of great value to the progressive businessman. We should utilize this staff service of our Government at Washington.

From the Editor's Mail Bag

C. Wilbur Miller, President, Davidson Chemical Company, of Baltimore, Md.

"I have had upon my mind for quite awhile the problems we must meet with regard to what you term 'Industrial Preparedness for Peace.' There is quite a difference of opinion as to what conditions will be in Europe after the war with regard to labor. It seems to me that for some time to come there will be a great lack of immigration into this country and the labor situation will be our most serious problem. Our company is planning in every way possible to improve that step of our progress, looking toward every possible improvement in a mechanical way to prevent lost energy from manual labor."

John Barneson, President, General Petroleum Company, San Francisco, Cal.

"I should say that first of all, legislative attacks against business and capital must cease and the attitude of the Government toward economic business combinations should undergo a material change, and conform more, say, to the German methods prior to the war.

"I do not see how it is possible for our businessmen to compete successfully with foreign business supported by the governments of those countries in the face of repeated attacks of every nature by our own Government. I should also say that labor must recognize the necessity for moderation in demands and cooperation with the employer, rather than attitude of distrust and antagonism with continued demands for higher rates of pay and lower hours of work, in lines that [illegible]

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Commercial America and the War

Present and Future Effects of the European War on Our Industries and Foreign Trade

By Hon. Edward Ewing Pratt, Chief of the Bureau of Foreign and Domestic Commerce, Washington, D C

MUCH has been said, and properly so, about preparedness. By the term "preparedness" we usually refer to preparedness for war We have in mind preparedness to resist an invader, or to protect our rights by force of arms

No matter how great our hope for peace, we may, some day, become involved in war, and we should be prepared. But we are certain that, following the great European conflagration, there will come a period of peace, and we must be prepared for peace

Our Present Prosperity and Its Contemporaneous Effects

The coming of a period of peace in Europe will bring with it consequences almost as grave as those that followed the outbreak of the war But in the mean while we have learned our great lesson,—that the United States was not, is not, and cannot be an isolated nation The United States is bound to other countries of the civilized world by ties closer than those of blood relationship The vital importance of those commercial ties was revealed to us only by the greatest war of all time. We did not realize our dependence upon Europe until we found our credit facilities snatched away from us the ships which had carried our commerce commandeered, the markets for many of our staple crops suddenly closed, and new markets with which we were unfamiliar suddenly thrust upon us We are not isolated, our interests are vitally bound up with the interests of other countries. We can no longer, facing the facts as they exist and facing the facts which have been driven home to us in the last few months, declare ourselves a nation apart and living unto ourselves alone

As long as the war in Europe continues with unabated vigor, the United States will continue in an abnormal and in fact, unhealthy economic position We must not be led into the fallacy of supposing that the phenomena of business life which we see about us to-day are normal, or will permanently endure The keen business man must carefully segregate those features in our commercial and industrial activities which are normal and will endure from those features which are war-caused and transient

This much, however, we can accept as true, that the longer the war lasts the deeper will be the impression on our economic life and the more permanent will be the effects. Already there have come into existence, by means of the abnormal world conditions, many factors which two short years ago would have been scoffed at as impossible The United States has assumed a position of commanding importance in the world of international finance We have contracted our output of cotton and have increased our output of wheat Many products which a few months ago we imported from Europe are now being manufactured by American concerns. Many manufacturers have found to their surprise that they can manufacture articles heretofore imported, and can manufacture them cheaper than they were manufactured in Europe These facts point to a complete change in the economic position of our country and lead us to the belief that conditions will be essentially different with us after the European war

While considering our own position, we must not forget that conditions in Europe will also be essentially different after the conclusion of the war We pity those great nations of Europe engaged as they are in a determined effort to destroy one another We regret the waste of capital and labor which can never be replaced. We admire their sacrifices and their sturdy, foresighted plans for rebuilding their economic organizations.

How European Powers Are Preparing for the Resumption of Normal Commerce

While this gigantic struggle is going on in Europe we bask in a hectic and unstable prosperity While cataclysmic economic changes are in process, we talk and congratulate ourselves that we are at peace and that things seem to be going well with us. We are all too calmly watching a struggle which has almost as vast and important consequences for us as for the contestants. But the European nations, even while engaged in a war that would seem to absorb every energy in the immediate struggle for existence have time to look ahead and to plan for the future Even now they are taking action to prevent or to carry out, as the case may be, an economic invasion. They foresee, as we must foresee, a giant struggle for commercial supremacy.

The Central Powers are even now planning a close alliance for commercial defense and for commercial offense. The Allied nations, especially those in Western Europe, are planning preferential tariff arrangements which will prevent their enemies from commercially invading their territory, and will give each the preference in the other's markets. Much has been said, and perhaps accurately, about the possibility of special and preferential tariff arrangements between Great Britain and her colonies. It is even possible, although not so probable, that Russia will permit her present allies to enter her markets on more favorable terms than others

The European nations are hard at work, collecting and collating material which will serve as the basis for the negotiation of new commercial treaties Great Britain is appointing commercial attachés in neutral and Allied countries and trade commissioners in her colonies She is collecting thousands of samples of manufactured products sold by her rivals in foreign markets France, even in the midst of her present difficulties is sending commissions composed of prominent officials and experts to many countries, our own included for the purpose of establishing closer trade relations Even the smaller countries of Europe are alert to the opportunities and dangers of the present situation

Probable Aftermath of the War and What We Must Do Now to Meet It

It is sometimes urged that the hatred engendered by war will soon pass away, that each country will seek the cheapest market, irrespective of nationality in which to buy In an unorganized market this would be true But Europe is not unorganized Legislation taxation, and organized public sentiment will be the means of continuing for decades, and even generations, the commercial struggle which will grow out of the armed conflict The United States, the innocent bystander, cannot expect altogether favorable treatment at the hands of either group

We may justly reverse the old saying, ' In time of peace prepare for war' and for us it should read In time of war prepare for peace

There are two phases of the aftermath of this war which we should carefully distinguish—the one has to do with immediate effects of the war and the second has to do with the ultimate and more or less permanent effects of the war

We have to look forward in the months immediately following the cessation of hostilities in Europe to the complete disarrangement of entire lines of industry those industries which have been stimulated by the demands of the warring nations for their belligerent activities It is likely that manufacturers of munitions, and of what might be called direct war supplies are alive to this situation, but there are two classes of manufacturers who are not in a position to see the matter clearly and who have not made adequate preparation. These are the manufacturers who are making the raw materials that go into munitions and the manufacturers who are producing goods which are not munitions, but for which the demand has been considerably stimulated by reason of the war Every manufacturer should consider carefully how far the demand for his products is stimulated by the war conditions and he should carefully write off against present profits the enlargements of his plant and equipment We have to look forward immediately following the war to a complete change in the trade routes of the world We cannot expect to be able to do business through the same commercial and financial centers or by the same methods that we did it before the war or during the war We must look forward to large readjustments in important markets We cannot expect to be able to maintain our position of supremacy in certain lines unless we have taken due precautions Following the cessation of hostilities there is likely to be a considerable reaction and it is up to us now, during this period of apparent prosperity, to prepare for what is sure to be a period of real but perhaps less apparent prosperity

The permanent or long time effects of the war which should interest us are not only those which immediately affect us, but also those in Europe which are of importance to us. The belligerent nations have suffered a tremendous loss of men, and consequently a loss of labor power Millions of men have lost their lives, other millions are maimed and diseased The labor supply of Europe is depleted and has lost much of its efficiency Europe's abundant supply of capital has been withdrawn from production, and is being spent for destruction. Much invested capital, in factories, machinery, mines, railroads and public works of all kinds, has been destroyed The belligerent nations will be saddled with immense debts For years to come taxes will be high and the burden upon every kind of business will be great Their fiscal affairs will be disorganized There is a bare possibility that the gold standard may be broken down and may be replaced by an arbitrary monetary standard Europe then, must look forward to a period of high costs of production and high price levels

Those effects are likely to exist for years decades or even generations We will also find many results which will extend over a long period and will tend to become permanent We must first of all reckon with the diminished producing power of Europe—our best customer We can look forward to some gains in markets which are outside of the war zone We can look forward to the increased independence of our domestic manufactures We can look forward to a more independent and more important financial position. And what perhaps is even more important we can be sure that the American people have acquired an international point of view a point of view which will prevent in the future the repetition of blunders in our foreign relations which we have so often made in the past

The Coming War for International Markets

No matter how certain these results of the European war may seem to be there is one result which is even more certain The European war will be succeeded by a period of world wide commercial and industrial competition It will be a period of competition as between the present belligerents to recoup their losses or to further conquests already accomplished It will be a period of competition as between the belligerents and as against us As for ourselves, we must realize that not only our foreign markets which we had before the war and which we have established since the beginning of the war but our own home market will be the object of commercial attack That nations depleted in every resource, reduced in labor supply, exhausted in capital and overburdened by taxation, will be able to compete successfully with an alert and prepared United States I believe to be impossible The essential question is, are we alert to the possibilities of the situation and are we commercially prepared? Are we alert to the fact that the other nations of the world, to whom sacrifice has become a daily routine have their very national existences at stake? Are we prepared to meet the advances of our competitors? Are we mobilized commercially and industrially to hold our position and to go forward?

Preparedness in Domestic Industries and Preparedness in Foreign Trade

Any program of preparedness for peace must comprehend preparedness at home and preparedness abroad We must be prepared not only to make ourselves economically and industrially independent, but we must be prepared to carry on an aggressive commercial campaign for foreign business which will be carried on in competition with the other nations of the world

We have prided ourselves on our independence but the European war has shown us how far our pride has led us astray We had political independence, but we could not even find a market for, or utilize ourselves some of our important staple crops A vast section of our country was in distress Even to-day we find our industries sadly cramped because we are unable to supply them with some of their essential raw materials We have natural resources but they are undeveloped

We must prepare to produce dyestuffs Our textile industries and many others are suffering for the want of dyestuffs We have the raw materials but we are not prepared to manufacture the finished product We must look to the future and if, as seems probable, our European competitors will be able to crush our growing dyestuff industry by unfair methods of competition we must be prepared for that emergency by the enactment of laws which will prohibit such methods of competition and will give our manufacturers a fair chance to establish their industry We are sorely in need of potash, which we have heretofore obtained from Europe Apparently, we have a considerable supply of the raw material but we have not manufactured the final product This we must also do if we are to get the best results from our agricultural lands There are many industries in which we are making progress toward independence We have been dependent upon Europe for a vast variety of articles which we must learn to make for ourselves We must make our own dyes, our

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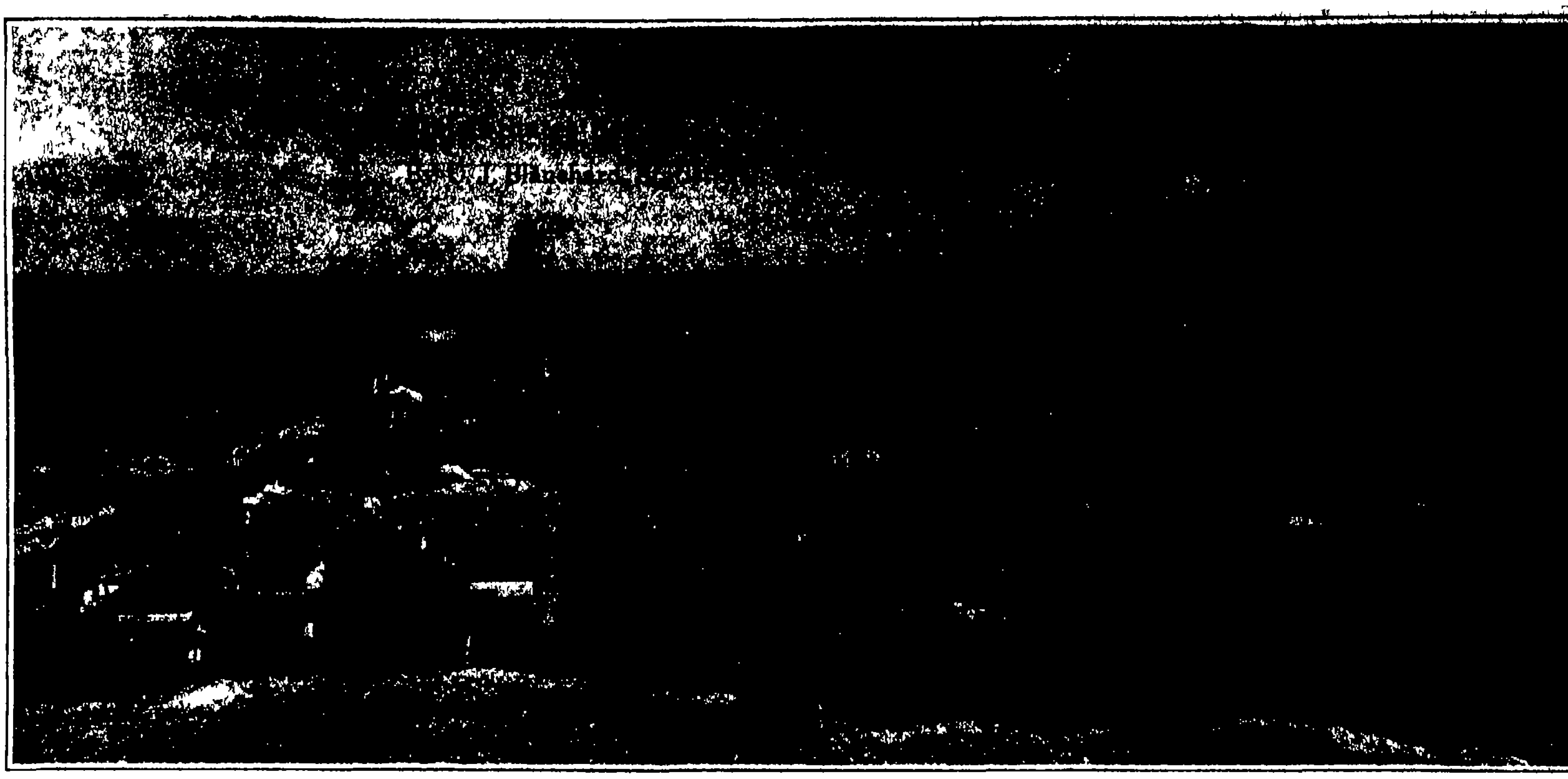


El Paso, Texas, a city that has grown up in the desert

IN the long vista of years stretching before us our Nation must prepare against attacks not only from without but also from within our borders. While preparedness against an outside foe is a duty immediate and important, the menace of a great population poorly housed and underfed calls for like consideration on the part of our lawmakers. Many economists are agreed that when the Dove of Peace builds its nest once more in war stricken Europe we may look for a return wave of aliens, probably the heaviest known for many years. In addition to this the natural increase in the number of our citizens who attain majority makes more complex the problem of wise distribution in order that congestion in our great cities may be prevented.

It is an economic axiom that the stability of a nation is assured only when the bulk of its citizens reside in their own homes. The ideals and principles for which our forefathers fought cannot be preserved and maintained by a citizenship whose interest in our Nation's integrity does not extend beyond mere wage earning. As Secretary of the Interior Lane aptly put it— "The highest sense of nationality comes from a sense of purpose—a sense of common purpose—for the United States is not yet ours in the proudest sense, and cannot be until we are doing all that can be done to give all its people and to the world the full expression of its highest intelligence applied alike to its resources and to the life of the people." A nation of tenement dwellers possesses neither inclination nor ability to defend itself. The late Henry Grady well said, 'A citizen standing in the doorway of his home, contented on his own threshold, his family gathered about his hearthstone while the evening of a well spent day closes in scenes and sounds that are dearest—he shall save the Republic when drum tap is futile and the barracks are deserted.' Making provision now for the millions of aliens who will flock to our shores and for millions of our sons and daughters who will want homes of their own is as necessary as the fortification of our coasts and the enlargement of our Army and Navy.

Bird's-eye view of the Arrowrock dam, Idaho

Nations like Germany, France and England, confronted with the same problem, find its solution only in the acquirement of new and distant territory. Thank God! We have yet within our own imperial domain vast areas scarcely touched which can be prepared for our homemakers. The man of Destiny for this herculanean task is the hydraulic engineer. Though colossal in its magnitude, the work nevertheless is so practicable and feasible that no doubt of its ultimate accomplishment clouds the mind.

The United States is a country of vast extent and almost unlimited resources. Our continental area is over 3,000,000 square miles. Of this fully a quarter is undeveloped. In the United States, exclusive of Alaska and our island possessions, there are 80,000,000 acres of swamp lands and 400,000,000 acres of deserts. What shall we do with this princely territory? Leave the one a pestilential disease breeding spot and the other a vacant and untilled wilderness? Why not live up to our boast of being the biggest and richest nation on earth, and tackle one with the drain and the other with the irrigation ditch?

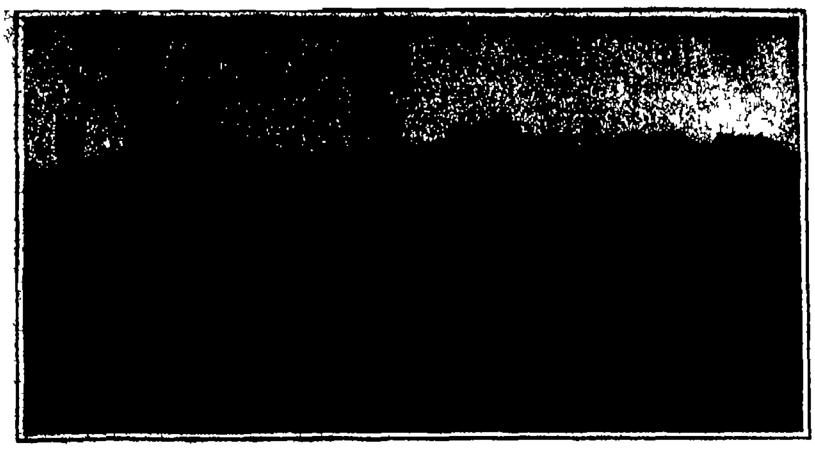
American genius has cut a gash across a continent to connect two great oceans. It has tunneled rivers and cities to facilitate transportation, it has conquered the primeval forests of our North Atlantic States and developed an empire of unparallel richness in the Mississippi Valley. With a sure swiftness and completeness where history nowhere else records since the Egyptian dynasts gathered the tribes of mankind together, our western march has developed the great interior valley and our Pacific slope. Shall we then delay longer the conquest of our vacant areas?

Our swamp and overflow lands embrace an area greater than that of the Philippines. These lands for the most part are adjacent to large centers of population, with excellent transportation facilities by rail and water. Their reclamation will give employment for years to hundreds of thousands of laborers, and later will afford opportunities for the establishment of approximately 2,500,000 families in homes of their own. Two harvests from these lands would suffice to pay the entire cost of reclamation. Hon Champ Clark, Speaker of the House of Representatives, has introduced a bill which, if enacted into a law, will provide a practical method for undertaking the task.

An enormous expansion of our agricultural and

West portal of the tunnel on the Truckee canal

Bringing water to the thirsty desert, Shoshone project, Wyoming



Arizona desert near Phoenix before reclamation

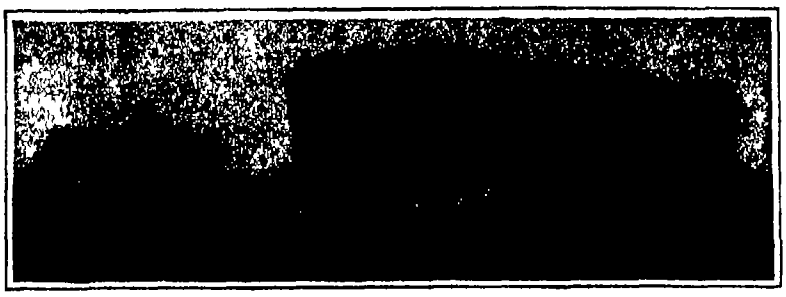
Irrigating ditch brings water into an Arizona ranch

manufacturing industries will surely follow the initiation of this work. From Texas on the southwest to the Atlantic Coast States on the east, northward to New Jersey, and including enormous areas in Minnesota, Illinois, Missouri, Arkansas, Tennessee, California, and Idaho, a new agricultural empire will be opened to settlement equivalent to the addition of a second New England. The value of our agricultural products will be increased $2,000,000,000 annually. Under a plan now successfully in operation in Australia our Government in coöperation with the several states could complete the work and be assured the full return of its investment and 4½ per cent interest. By the issue of amortization bonds extending over a period of 31½ years with 6 per cent interest, 4½ per cent on principal and 1½ on amortized payments, the entire investment would be returned. The bonds would be secured by the land and improvements, and this security would be improved with each year's development work of the farmer. By guaranteeing these bonds the Government would be able to dispose of them at a premium which would more than meet all expenses of issuance and collection. In the settlement of these lands the assistance of the Departments of the Interior and Labor would be available through their settlement and employment bureaus. To obviate possibility of undue speculation the lands before reclamation should be acquired under appraisal and condemnation. By this method the settler will not be compelled to pay commissions to real estate dealers often ranging from 15 to 40 per cent of the selling price.

Bonds would be issued only when required to keep the work under way. To further guarantee the success of the settler each state should establish a fund to be advanced for the purchase of stock and equipment and repaid under similar amortization payments running 31 years.

What Our Desert Offers

The boundaries of arid and semi-arid United States roughly include two fifths of our continental area exclusive of Alaska. Here is a region of unparalleled resources of soil, diversity of topography, and favorable climate. It is the most truly American part of America, the most enterprising, and the most unsettled. It is peopled with a larger percentage of our native born than New England. The remaining public lands are largely located in rainless regions, and their acquirement by homemakers cannot proceed until they have been made cultivable. Reconnaissance surveys and stream gaging made by the Government during the past 20 years have given us fairly accurate knowledge of the conditions, and we are able to predicate reasonably the limits of future development of this extensive area.



The electrical high school at Rupert, Idaho

It is well known that our desert areas are far in excess of the natural water supply. While the former include several hundred millions of acres, the latter will not suffice for the needs of more than 40,000,000 acres. In the preparation of this irrigable area for homemakers the construction of enormous engineering works for storage of floods will be required. Hundreds of thousands of miles of main canals and ditches must be laid across the desert, and elaborate systems of distribution must be planned.

Here is a territory won to us by war, treaty, discovery and purchase. Flying at one time the flags of four nations, its history is rich in thrilling incident and adventure. Its milestones are the bones of trappers, explorers, and pioneers. Its people are strong and courageous. To battle with the elemental forces of Nature has become a passion. They are captivated by the immensity of the field in which they operate and the majestic scale on which things are done. It is a race of unequaled energy and optimism. While the glamour of romance which enwrapped this region in years agone is dispelled, it is still romance land, but with a new background. The romance of creation now pervades the once silent desert and the dominating thought and impulse of the new land is to establish here the well ordered life of New England with all the highly organized facilities for making existence in the country attractive, comfortable and sufficient. There are many communities dwelling to-day in the valleys of the Snake and Yellowstone rivers and at the feet of the snow-capped Rockies and Sierras to whom this vision and hope are ever present.

What We Are Doing in the Desert

American capital, genius, and pluck already have wrested from aridity 15,000,000 acres, and planted thereon 200,000 families in independent homes. In crops alone these lands are each year returning more than 300,000,000 dollars to the farmers. The taxable wealth of this new empire is estimated to exceed the entire wealth of the Nation in 1800, yet the work is only in its infancy. The remotest parts of our desert are being connected by railroads carrying the commerce of the world. Cities populous and prosperous have risen in the desert and have attained commercial and mercantile greatness. In the swift march of events the National Government until recently had but small part. It was not until 1902 that the insistent demands of the west won recognition at the lands of Congress. At that time the efforts of private enterprises had covered the field which was open to their limited capital and a period

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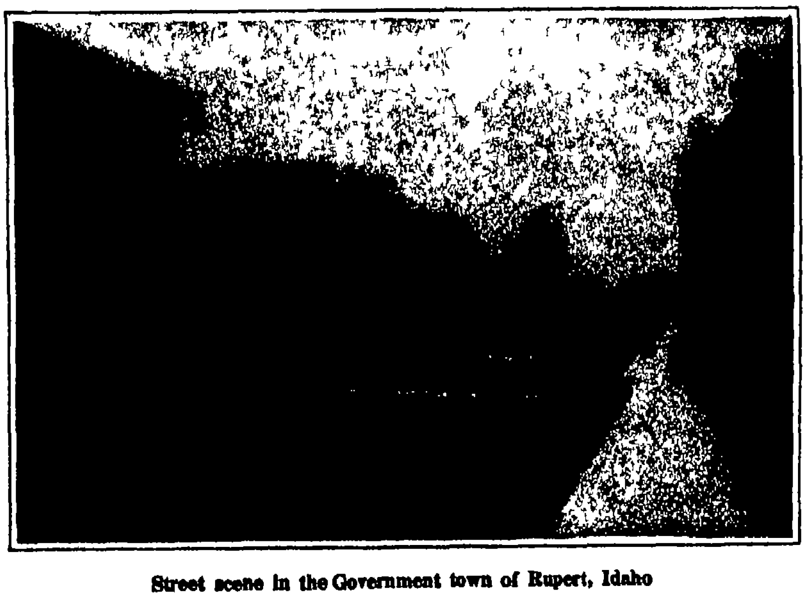
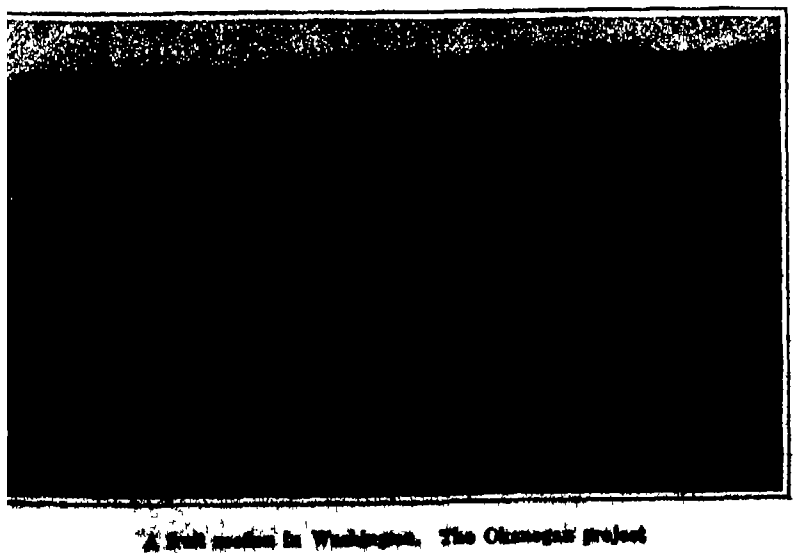
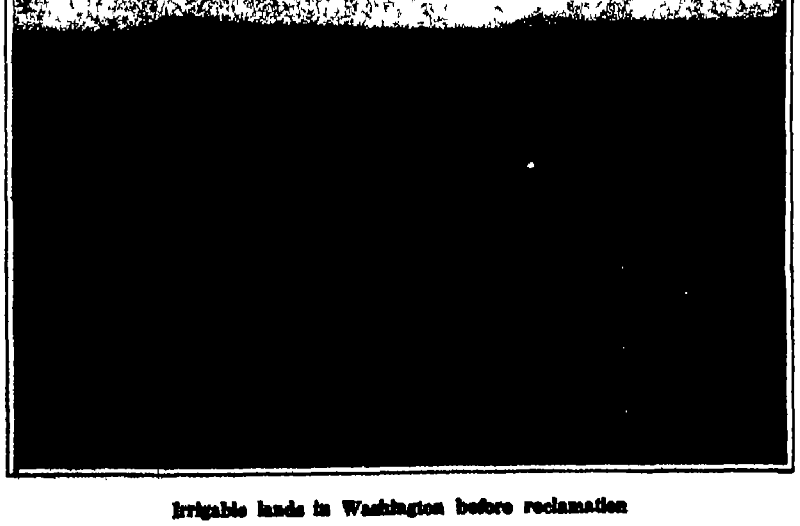


Street scene in the Government town of Rupert, Idaho



A fruit section in Washington. The Okanogan project



Irrigable lands in Washington before reclamation

The Naval Losses of the Allies

A Fleet of Thirty-Two Major War Vessels Sent to the Bottom of the Sea

THERE are many ways in which the results of war on land are obvious to the follower of its progress. There is a well defined theater of control on the part of each belligerent at the beginning of operations, and a somewhat less defined idea of the number of troops and quantities of munitions available We are startled by the accounts of the number of men involved the casualties incurred and the munitions expended But the main and final impression of the results achieved is measured by the value commercially politically and strategically of the enemy territory occupied

In order to get impressions of the results of the naval warfare of the present struggle it is necessary to approach it from corresponding points of view

We have read with varying emotions of the sinking of this or that warship in some remote or unknown theater of naval operations but with small understanding of the result attained, other than the destruction of the particular naval unit in question

On the other hand while the number of men disabled and the ammunition expended strike us similarly in each individual case reported, the occasional lists of the total casualties bring strikingly before us the enormity of the totals

It has been our purpose to summarize graphically the destruction at sea in order that the extent of it can be properly realized However before proceeding a brief review of the naval situation will clarify in some measure the results attained in addition to the destruction effected

The sea in so far as naval warfare is concerned, may be considered as that portion of navigable waters outside the range of land fortifications Warships are built to control the use of the sea as thus defined

At the outbreak of the war the preponderance of the allied fleet was sufficient to give it virtual control of the seas The Central Powers, recognizing the situation, concentrated their vessels so far as possible in home waters. Those unable to seek this shelter, on account of the hazards involved without adequate returns cruised in remote waters less efficiently policed Here it was possible to prey on the enemy's commerce while awaiting conflict on more nearly equal terms

From the first then the control of the sea has been conceded to the Allies except for the guerilla warfare of these isolated vessels, and the first stage of the naval warfare consisted in clearing up the ocean of the daring marauders who temporarily disputed the allied control in remote seas

The completion of this task was accomplished, not without loss to the Allies The principal units lost to the British in this phase were the "Good Hope" a cruiser of 14,100 tons, the "Monmouth" a cruiser of 9,800 tons, in Admiral Craddock's ill fated squadron on the west coast of Chile, and the "Pegasus," a light cruiser of 2,135 tons sunk by the "Koenigsberg" at Zanzibar These naval losses may be considered light for the results obtained

As the Teutons have not felt inclined to major operations, the succeeding allied operations, with one exception have been with the object of restraining raids and submarine activity The exception consists of the Dardanelles campaign where second line or pre dreadnought battleships were employed out of their normal sphere to reduce fortifications which subsequent events proved were more capable of resistance than anticipated A modern vessel the "Queen Elizabeth," was frequently mentioned in the bombardments that occurred but it is probable that owing to the range of her 15 in guns it was not necessary and presumably never intended that she should come within range of the forts, or that she should be exposed to the floating mines and possible torpedo attack in the straits

Of the vessels engaged within the danger zone, the Allies lost heavily The battleships "Irresistible," "Ocean," "Goliath" "Triumph," "Majestic," "Bouvet" and "Leon Gambetta" were the major units lost but the losses also included a number of submarines and transports

From the experience gained in this adventure it is extremely unlikely that important ships will be jeopardized in similar campaigns.

The Allies' problem henceforth became one of repressing any German naval activity This took two forms one, the raid in force, the other, the war of attrition by the sowing of mines and torpedoing by submarines

The second raid in force, with a squadron of powerful high speed battle cruisers and cruisers, encountered Admiral Beatty's battle cruiser squadron This resulted in the loss of the "Bluecher" and serious injuries to other German vessels.

Important injuries occurred to the British vessels, notably the battle cruiser "Lion," in this engagement, but the damage inflicted upon the enemy raiders was sufficient to prevent a recurrence of raids by sea up to the present writing In this instance important results were accomplished without loss of vessels to the Allies

The destruction incident to mines, navigation, and the dangerous explosives carried forms an important part of the total and is a part of the unfortunate losses which must be counted upon in the vigorous prosecution of any war The proportion of this damage to the whole is much greater in the present war than it would be in one where the control of the sea was disputed In this category has come the principal naval loss of the Allies, so far in the war, through the sinking of the dreadnought "Audacious" off the Irish coast The "King Edward," "Bulwark," "Natal," and "Benedetto Brin" were also lost in this way The remaining method of harassing the Allies, and the one that continues, is through the use of the submarine

Naval opinion received an impressive shock when the news of the torpedoing of the cruisers "Hogue," "Aboukir" and "Cressy" was flashed round the world This event undoubtedly modified the allied scheme of sea patrol Numerous other war vessels have since fallen prey to the submarine, notably the "Formidable," "Majestic," "Amalfi," and "Giuseppe Garibaldi," though the principal field in which they are feared is in commercial traffic

Altogether, the number of allied war vessels destroyed from one cause or another looms large but the conditions existing on the sea have not been changed thereby In fact, their grip on the situation is tighter and more secure as time passes The Allies have the immense shipbuilding capacity of the British Isles to thank for their improved situation

As long as the war shall last this industry will continue in feverish activity to produce warships in numbers and types deemed necessary to cope with their antagonists

In next week's issue of the SCIENTIFIC AMERICAN we shall publish an article and full page illustration of the Teutonic naval losses

Patent Office Reorganization

THE Patent Office reorganization under the new law just approved by the President was based upon the principles of adjusting the work of that important branch of the Government to the new conditions The old organization had been expanded to meet the growth of the business until it failed to be as effective as it should be Its foundations were inadequate The system worked out by Commissioner Thomas Ewing, which by mischance failed of enactment in the last hours of the last Congress but which has been given prompt passage now, establishes a broader foundation and takes into account the very greatly increased responsibilities that rest upon the office, with some increases of compensation and with provisions against stoppages in the working of the system of hearing appeals

An important change is that which gives the Commissioner discretion in the matter of appointing women as assistant examiners. Heretofore the law permitted two woman assistant examiners but this limitation is removed and as Commissioner Ewing holds that women make excellent workers in this field, it is possible that in the reorganization of the system through new appointments women may appear in the personnel

It has been often urged that in the reorganization of the patent system provision should be made for a special Court of Appeals to replace the present Court of Appeals, which now has jurisdiction. Many cases are carried up from the Interior Department to the judiciary on appeals involving questions of law, and sometimes a determination of facts These law and fact questions call for special consideration, and it is not an infrequent experience of patent lawyers to have judges acknowledge their entire unfamiliarity with such questions. In Washington this is not likely to be the case, because here occur most of the patent appeals, and the Court of Appeals has become to a large extent technically qualified in this particular class of cases, but on the circuit these patent cases are often heard by courts without any experience whatever A court of patent appeals similar to the Court of Customs Appeals would greatly relieve the present appellate court system and would facilitate the disposition of these cases, which involve enormous pecuniary interests. It might be a circuit court, moving from city to city to facilitate hearings and the convenience of litigants. Many of these appeal patent cases involve conflicting claims between individuals and corporations, and sometimes great industrial interests are involved So important are the issues that the United States would be justified in creating a new tribunal for this special work.

The Conservation of Platinum

THE Director of Materials in the new British Ministry of Munitions has addressed a circular to dealers in platinum, requiring them to make a return of the whole of their stocks of this metal and forbidding any trading without a permit. *Nature*, commenting on this step, expresses regret that it was not taken sooner, as "it is most unfortunate that this rare, and for many purposes indispensable, metal has been allowed to be used for jewelry and purely ornamental purposes. Either silver or gold," says this journal, "is much better adapted to the production of attractive ornaments and is more beautiful than the grayish white of platinum, while, of course, neither has the high melting-point, electrical resistance and chemical refractory qualities which make platinum so valuable a metal both in science and in the arts." In consequence of the war the annual output dropped from 300,000 to 250,000 troy ounces. About 95 per cent of the world's supply comes from Russia

Efficient Vision

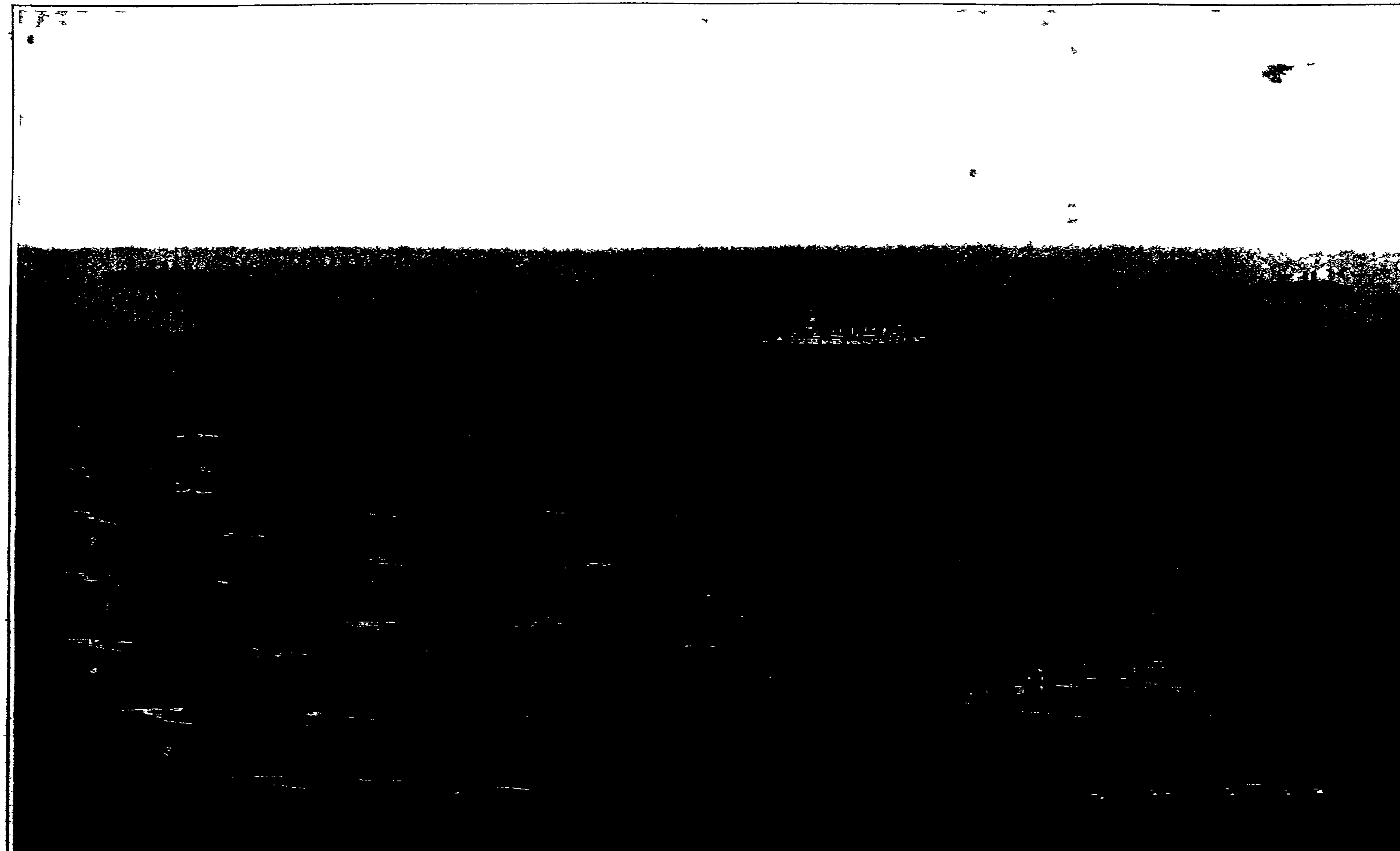
AMONG the many circumstances in modern civilization tending to impair human vision is improper illumination, either natural or artificial Too intense light is as bad, perhaps worse than, poor lighting Eyes are not merely optical adjuncts, they are integral parts of the body really expanded portions of the brain. They mutually affect the functioning of most other organs, inefficient eyes cause many chronic headaches, much depression and bodily fatigue, most indigestions, many (some believe, practically all) of the abberations of genius and of the alleged *demi fous*, the half witted

Any organ exercised well within its limits tends to increase in power and facility, if persistently overworked it becomes progressively unable for any work at all One habitually using his eyes in strong light decomposes his "visual purple" faster than it can be regenerated Even normal eyes are ruined by overuse, especially in lowered general health, and as most eyes are abnormal, or at least not perfect as visual machinery, many people have to cope not only with bad environment and lowered health, but also with inherent optical defects. Doctor Ellice M Alger, whose knowledge of the eye is peculiarly full and exact, considers that because of the many newly invented methods of commercial lighting, by gas and by electricity, the composition of light as well as its intensity have come to require serious consideration In the days, and nights, of oil and candle light, the question was simply one of quantity, the quality being generally soft and benignant, but modern lighting, whether gas or electric, is often so intense as to be injurious; these latter means of illumination contain many more of the violet and ultra violet rays of the spectrum than our fathers were accustomed to. Such rays are useful in the treatment of disease by light and in radiography, but they are certainly amiss for illuminating the printed page or the object on which the artisan must work. Lights that can tan and sunburn the skin, and perhaps induce baldness, are no doubt responsible for much of the present-day visual weakness. The effect of such illumination on the deeper optical structures is certainly pernicious. It is very likely much cataract comes from this cause, certain it is that stokers, glassblowers and other workers in intense light and heat, are enormously prone to this grievous eye disease.

Illumination made up of red and yellow rays of the spectrum is the best for visual purposes. The problem of securing a light which shall allow a maximum of efficiency, comfort and convenience is one more within the province of the illuminating engineer than of the physician to solve. The solution was not only a humane procedure, but one which should be also very profitable to inventor, to employer, to employee, and to all who read—that is, to everybody

Another State Geographical Society

THE valuable work accomplished by local geographical societies is well known, and we are therefore glad to record that a state geographical society has been organized in New Mexico. Its chief functions, as announced in the *University of New Mexico Weekly*, will be to recommend nomenclature for various historical places and landmarks, to gather information concerning such places, and especially to preserve old Spanish and Indian names. Dr. D. R. Boyd, president of the university, has been elected president of the society.



WAR VESSELS LOST BY ENGLAND, FRANCE, RUSSIA, ITALY AND JAPAN DURING THE PRESENT WAR UP TO FEB. 25th, 1916

1 *Audacious* 15 *Hawke*
2 *Triumph* 16 *Benedetto Brin*
3 *Bulwark* 17 *Amalfi*
4 *Irresistible* 18 *Bouvet*
5 *Ocean* 19 *Garibaldi*
6 *Argyll* 20 *Pallada* 29 *Casabianca*
Good Hope 21 *Takachiho* 30 *Leon Gambetta*
8 *Formidable* 22 *Jemtchug* 31 *Arethusa*
9 *Majestic* 23 *Hermes* 32 *Amiral Charner*
10 *Monmouth* 24 *Amphion*
11 *Cressy* 25 *Viger*
12 *Aboukir* 26 *Pathfinder*
13 *Hogue* 27 *Pegasus*
14 *Goliath* 28 *Speedy*

Strategic Moves of the War, February 24th, 1916

By Our Military Expert

THE capture of Erzerum by the Russian forces in the Caucasus has been foreseen indicated by the slow but consistent advance of the Grand Duke, for some time The fall of this fortress is, of course, but a necessary incident in the accomplishment of the larger objective which seems to demonstrate the first concrete result of coöperative strategy between the Powers of the Entente

A general survey of the war map of Europe shows that the Teutonic power is practically hemmed in Emergence by Germany from the Baltic on the north is stopped by the sea power of England, the English Belgians and French block the west, Holland and Switzerland are hornets nests that nobody cares to poke Italy binds the landward south flanked by the Adriatic and the Mediterranean even though the Kaiser's legions overrun Albania, Greece for all purposes of gaining touch with the outside world is locked to Teutonia and the Entente holds the key On the East Russia from Riga to the Roumanian frontier seems solidly athwart the roadway backed by the numberless man power of the Czar, there is no egress through Roumania even though she declare for the Central Empires, a development which seems more remote with the passing of each day Bulgaria is bound by the waters of the Black Sea dominated by the Russian fleet and the circle of steel is complete save for the proportionately narrow pass between the Black Sea and the Agean Turkish territory won to the Kaiser's arms through diplomacy and a desperate cast of the die by the Ottoman Empire

Glance again at the map The peninsula of Asia Minor extends from the eastward between the Black Sea and the Mediterranean, like a sore thumb The distance from the Gulf of Alexandretta where the Mediterranean jabs upward into the peninsula to the closest point on the Black Sea is but three hundred miles, through the southern part of which the one great artery of commerce and war in that section the Bagdad Railway runs A successful occupation of this neck of land by the forces of the Entente would sever the main portion of the Turkish Empire from touch with its dominating allies, remove all threat to the colonial possessions of Great Britain the backbone of the Entente, mainly through its sea power and would forge the last link in a chain completely enclosing Teutonia, block the only existing gap remaining for expansion and the drawing of supplies from without, and complete the enceinte of a monumental siege

This peninsula, then, by reason of geography that cannot be denied constitutes the local desired objective of the Russian operations Desire and accomplishment are different things, of course, and it is inconceivable that Teutonia will not bend strenuous effort to prevent the latter, even at cost of weakening needed strength elsewhere The German staff has demonstrated a viciously effective way of doing such things ever since the war began and the only likelihood of success to the Entente lies in combined operations on several fronts to hold their opponents in place, to deny them the possibility of detaching massive forces for an offensive defensive in Asia Minor

As the Russian advance continues the way will become harder for two principal reasons as the peninsula is approached the Russian forces must draw farther and farther from their railway line of supply the railhead base at Kars and consistently the Teutonic armies will come into closer touch with their base communications, secondly the shorter the distance from Teutonia proper as Turkish forces fall back the easier it will be the less risk through the time element will be experienced for reinforcements to be shifted

Yet the Russians always have the Black Sea As soon as the coast line is uncovered by advance upon Trebizond which even now appears to be under way, the railway line in rear of the Grand Duke can be more and more dispensed with for the supply of the entire line for this sea offers fairly free line of supply, becoming more valuable as more coast is gained

As the great body of the Turkish country lies to the southward of the present position of the Army of the Caucasus it is obvious that the pivoting movement which will certainly mark the progress of Russia—if progress it is to be—must hinge on the Black Sea, or, at least, to the northward Trebizond offers a first foothold as a preliminary pivotal point from which the armies of the Czar may swing in mighty sweep upon the neck of the peninsula a gigantic hammer driving home one last great plug

Well to the center of the most likely line across the neck of the peninsula lies Sivas the next stronghold of moment after Erzerum It is naturally a conspicuous point in the course of the advance and it is approximately two hundred miles from the present position of the Russian forces, from ten to fifteen average marches across the rough country if it were not necessary to battle for each step of progress

But the character of the country over which an advance upon this point is necessary is forbidding in the extreme The great valleys that gouge the land offer practically the only avenues of approach for interlocking mountain ranges strew the terrain from the crags and pass eminences of which stubborn defense may be offered against even greatly superior numbers The Russian line cannot swing around in its ideal chop toward the peninsula unless it is extended southward to embrace that territory wherein the English forces at Kut-el Amara are isolated for otherwise the swinging flank would be exposed to attack and the communications seriously threatened by almost any enterprising force of size that might be massed in the vicinity

The war in Asia Minor

It is currently reported that news of the Russian success at Erzerum has effected a burst of enthusiasm in Roumania for the Entente cause How much of this is true and how much is merely propaganda remains to be seen It is apparently true that with the reverses experienced by Russian strength resulting from the thrusting back through Poland and Galicia, the faith of the Balkan states in their ponderous neighbor of the North was severely shaken The Balkan states were strewn with information by Germany entirely justifiable in war that magnified the Teutonic success and proclaimed the almost unimpeded progress of their arms Diplomatic bribes, offers promises, were scattered broadcast, assuring favor and fortune to these states should they at least remain neutral, and they conveyed dark threats of condign punishment should these same states raise a hand against the Kaiser As a result the Balkan people, newly organized states, jealous of one another to the point of hatred feared for the integrity of their possessions, with the black example of chastised, destroyed Serbia and Belgium dangled before their frightened eyes

But Roumania, as well as the rest of these states, is ambitious for expansion and development, Russia is in a position to give her desired territory, and the ethnological bonds of the locality on each side of the frontiers are sufficient to inspire a natural sympathy for individual Slav to Slav

Local success sways the expression of sentiment which has necessarily been kept concealed through expediency, more and more, according to the reports of observers it is coming to be recognized, even in the Balkans, that Germany's desired Place in the Sun must be found toward Asia, with the concomitant deduction that should it be gained the lesser states that line the roadway from the heart of Teutonia to Asia must in the end become but dependencies of the preponderant might of the Kaiser—or possibly of an expanded Teutonic empire so strong that no power on earth could upset it And also the belief that if such a result should obtain, these little states would lose their individuality and independence, despite every promise given in the agony of supreme effort or by evanescent tracings on "Scraps of Paper" That unfortunate phrase is likely to cost an empire

To the analytical minds of the statesmen who guide the destinies of the Balkans, Germany's definite check must be apparent the power of vastly superior numbers, on a ratio of two to one, cannot be ignored, for even the machinations of desire cannot juggle with cold, impassive figures, and the drain, drain, drain of the countries at war, in finance commerce, treasure and blood, leads to comparison one contender has the entire outside world upon which to draw for supplies—the other has but its own definite territory, limited by bayonets, for the sum of its resources

Dispatches state that Russia is massing force in the vicinity of Roumania, not as a threat, but as a guarantee that the Roumanian forces may be concentrated on the Bulgarian frontier Roumania is practically mobilized, without doubt she is approaching a decision of some sort, and the recent Russian successes in the Caucasus are apt to have a much more far reaching effect than merely upon the local issue in Turkey

Saloniki has become formidable in strength and it lies in a very threatening proximity to Bulgarian territory That the city has not been attacked, as threatened, by Teutonia leads to the belief that the Kaiser regards the Roumanian situation so threatening that he cannot dare unguard it, and has not himself sufficient strength to launch attack upon the Grecian city And, furthermore, that the fear that Greece itself might be forced to declare actively for the Entente should Bulgaria, hated of Greece, invade her soil, acts as a restraint. The situation is fraught with moment.

If it be true that Roumania is to declare for the Entente actively with the completion of an understanding with Russia, a new line of attack across its frontiers, upon Austria Hungary, will be opened, supplemented by offensive action from Saloniki that might easily result in clipping Turkey from the alliance, force the Teutonic line back to within its own territory and mark the beginning of a second stage of the war, wherein Teutonia becomes definitely besieged in grim, overwhelming strength.

And this *possibility* exists to-day through the latest success of Grand Duke Nicholas with his Army of the Caucasus at Erzerum.

As we go to press the great German drive at Verdun is in progress A discussion of the strategic importance of this movement is reserved for the next issue.

Climatic Statistics for Canada

AMONG countries that have long maintained meteorological services there is great diversity in the extent to which the observations collected by those services have been digested and published in the form of climatic statistics. Canada, though it possesses an excellent meteorological service, has been quite backward in this respect. Hence much interest attaches to the recent publication of a substantial quarto volume entitled "The Temperature and Precipitation of British Columbia," constituting the first of a series of works which the Canadian Meteorological Office plans to issue for the various divisions of the Dominion. The next volume in the series will deal with the Northwestern Provinces.

The American Conquest of the Air

Shall the United States Pay Further Tribute to Other Nations for Her Supply of Combined Nitrogen?

By Prof Thomas H Norton, Ph.D , Sc.D., Bureau of Foreign and Domestic Commerce, Washington, D C

THE author of the accompanying article is well known to the readers of the SCIENTIFIC AMERICAN *through his contributions on "The Dyestuff Famine" and "The Potash Famine," and on allied economic problems His extensive report on "The Utilization of Atmospheric Nitrogen" published by the Department of Commerce in 1912 is regarded by electro-chemists on both sides of the Atlantic as the most complete and exhaustive treatise on the subject in any language* —EDITOR.

THERE is something galling in the word "tribute" to a free people. It recalls the exactions of Assyrian, Egyptian and other Oriental potentates, as recorded in Holy Writ, and in the monumental records of ancient civilizations It recalls the streams of gold flowing from every quarter of the globe into the treasury of Imperial Rome, or the chief sources of income of aggressive barons, kinglets and kings, through medieval history to the present day

And yet, the American nation has been regularly paying tribute for years to foreign interests, in a sense of the word quite as real as that characterizing the exactions of roving Vikings or Algerian Deys

The contributions do not take the form of chests of gold or silver as in the olden times. They cross the oceans in a steady stream of drafts and bills of exchange, representing just as truly the toil of American brain and brawn as would the precious metals

In an economic sense, I do not hesitate to designate as 'tribute' whatever we pay to foreign producers of staple articles of consumption, when our needed supplies can just as advantageously be produced on American soil and especially when they can be made from American raw materials

A careless neglectful policy in this field subjects us to a triple handicap The latent natural wealth of the country lies dormant and a magnificent national asset fails of utilization. The various industries dependent upon foreign supplies in this category must contend with all the uncertainty and vicissitudes attendant upon alterations in the economic conditions of distant lands and lack the confidence and assurance resultant from the existence in our own country of a well rounded cycle of productive activities Finally the entire industrial fabric of the United States is exposed directly or indirectly to the dangers of paralysis, through any interruption in maritime communications with other parts of the globe The evidence in proof of these theses has been brought abundantly to our attention in the form of scores of uncomfortable object lessons during the last eighteen months

We have paid a heavy tribute to the great factories on the Rhine, the Main and the Spree, for artificial colors and other coal tar products The present dislocation of our vast textile interests in the throes of an acute 'dyestuff famine," shows vividly the punishment—economically and literally—for the folly and unwisdom of violating the fundamental precepts outlined above

We have paid a still heavier tribute to the potash mines of Stassfurt and to the Prussian government The faltering harvests of our cotton and tobacco fields tell the tale of our penalty

The heaviest tribute is paid to foreign countries for our supply of combined nitrogen imperatively necessary for a multitude of industries, and, above all for maintaining the fertility of our farms

The tribute has amounted annually to over $29 000,000 *Every cent of this sum should have remained within our borders!*

For what and to whom has this vast toll been paid? Prior to the present war our annual imports of crude nitrogenous material averaged as follows

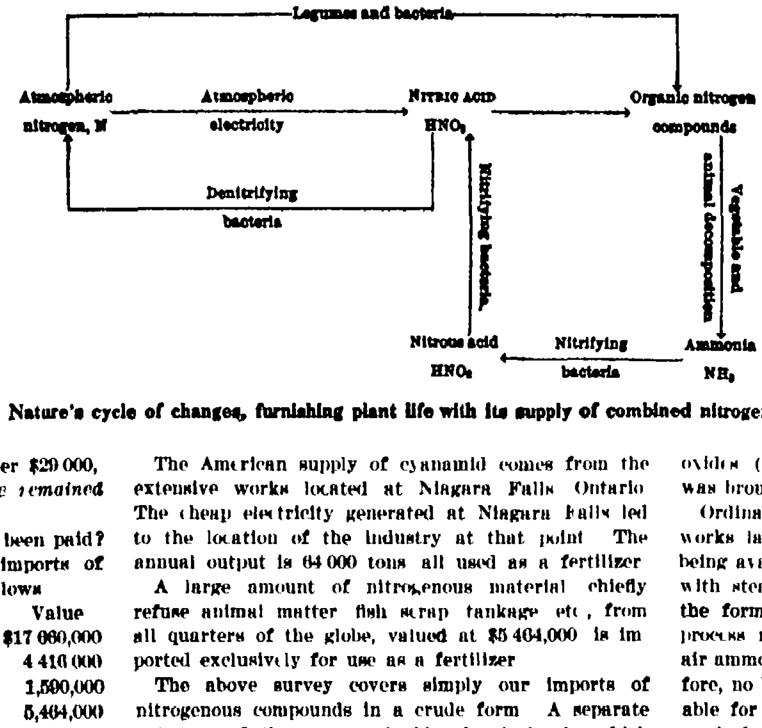
	Long tons	Value
Sodium nitrate (Chile saltpeter)	546,000	$17 660,000
Ammonium sulphate ..	67,200	4 410 000
Calcium cyanamid	29,500	1,590,000
Divers nitrogenous fertilizers....		5,464,000
Total		$29,130 000

The sodium nitrate came entirely from Chile The export tax on their shipments of this product forms about two thirds of the regular income of the Chilean government. In Europe about 80 per cent of the imports of the nitrate is used for fertilizing purposes In this country the proportion is much smaller In 1905, when the importation was much less than at present, Prof. C E Munroe estimated that it was consumed in the following manner

	Short tons
Explosives	133 000
Enameling, fluxing, pickling etc	68,000
Fertilizers	42,000
General chemicals	38,000
Nitric and sulphuric acids .	29,000
Glass making	12,000
Dyestuffs	260
	322,260

Ammonium sulphate is supplied chiefly by Great Britain—70 per cent, Germany has furnished 20 per cent of the import and Canada 7 per cent. Its chief use is as a fertilizer

Oats grown with and without cyanamid fertilizer
Effect of a ratio of combined nitrogen on plant growth



Nature's cycle of changes, furnishing plant life with its supply of combined nitrogen

The American supply of cyanamid comes from the extensive works located at Niagara Falls Ontario The cheap electricity generated at Niagara Falls led to the location of the industry at that point The annual output is 64 000 tons all used as a fertilizer

A large amount of nitrogenous material chiefly refuse animal matter fish scrap tankage etc , from all quarters of the globe, valued at $5 464,000 is imported exclusively for use as a fertilizer

The above survey covers simply our imports of nitrogenous compounds in a crude form A separate category of the more valuable chemicals, in which combined nitrogen forms an essential part such as the coal tar dyes and other coal tar derivatives (medicinals, etc), the explosives collodion, celluloid and other pyroxylins the prussiates the cyanides the nitrates etc , would include imports valued at about $12,500,000 These come entirely from Europe, chiefly from Germany

We are thus dependent upon other countries for wares containing nitrogen in a combined form, to the value of nearly $42,000,000 per annum

To what extent are we producing nitrogen in a crude, combined form?

The direct production is limited chiefly to the recovery of ammonium sulphate among the by products of the distillation of coal, in connection with the manufacture of gas, and especially of coke. The annual output for 1913 and 1914 was 190 000 short tons.

The utilization of waste nitrogenous material of animal and vegetable origin in American fertilizer works is considerable. Thus in 1909 it amounted to 1 085,000 short tons, valued at $20 277 000 Nearly three quarters of this is of domestic origin

Summarizing the nitrogen situation in the United States as far as crude nitrogen compounds are concerned we consume waste animal and vegetable matter valued at about $20 800 000 of which imported materials are worth about $5 500 000 We consume 265 000 short tons of ammonium sulphate of which 75 000 tons are imported We consume 33 000 short tons of cyanamid, all imported Finally we consume 610 000 short tons of sodium nitrate all imported

It is not difficult to realize what would happen to our agriculture and to our whole industrial system should for any reason our maritime communications with Europe to the east and with Chile to the south be interrupted for any length of time

We can picture the effects on simply our means of protecting the nation from foreign invasion

Our entire supply of nitric acid is obtained from Chile saltpeter In the manufacture of powder for cartridges or for use in cannon in the preparation of high explosives for use in shells or torpedoes, nitric acid is the most important the all essential material We may start from glycerin from cotton linters, from wood pulp, from carbolic acid, from aniline from toluene or from divers other coal tar products—in every case nitric acid is the agent needed to transform inert substances into powerful explosives.

Modern warfare as exemplified in the terrible world conflict across the waters is a battle of engineers and chemists In its ultimate analysis war is reduced to a simple term--nitric acid! The nation engaged in a struggle for life or death becomes helpless the day its stock of nitric acid is exhausted no matter what its population may number, no matter what their bravery skill and resoluteness

In almost as strong terms may we postulate the conditions of existence for a nation's industry or agriculture

We owe much to the examples of German efficiency in the most diversified fields of human efforts What lesson can Germany teach us in this connection? That empire is as effectually cut off from supplies of Chile saltpeter as our own country might be under certain contingencies

A decade ago the manufacture of cyanamid from the nitrogen of the air was successfully started at several points in Germany The industry has steadily expanded Four years ago Professor Haber's charmingly simple process for the synthetic manufacture of ammonia from hydrogen and atmospheric nitrogen was perfected, and a large plant for the industrial production of this important compound was erected At about the same time the equally brilliant and simple process of Professor Ostwald for the catalytic transformation of ammonia in the presence of air into nitrous and nitric oxides (yielding nitric acid on contact with water) was brought to a state of technical perfection

Ordinarily Germany produces from her coke and gas works large amounts of ammonia, a notable surplus being available for exportation Cyanamid on contact with steam gives off all of its combined nitrogen in the form of ammonia. To cap the climax, Haber's process renders it possible to manufacture from the air ammonia in unlimited quantities There were, therefore, no bounds set to the stock of raw material available for transformation into nitric acid by Ostwald's method, in 1914

Is there not here a magnificent example of how a nation can free itself from the shackles of dependence upon foreign sources for supplies vitally essential to its agriculture its industries and to national defense?

Let us note our own preparedness for the unexpected in regard to sources of combined nitrogen and in the equipment needed to render it available for use in the arts and in the preparation of fertilizers

First of all our assets

In the vast deposits of coal in this country there is enough nitrogen stored up to meet our normal demands for many years if carefully recovered in connection with coking and gas manufacture In these branches every short ton of bituminous coal should yield on distillation about 21 4 lbs of ammonium sulphate In 1913 over 75 000 000 tons of coal were distilled If the by products had been carefully recovered the output of ammonium sulphate would have slightly exceeded 800 000 tons The actual amount recovered was

(Concluded on page 258)

The Heavens in March, 1916

Our Neighbor Mars and Its So-Called "Canals"

By Prof. Henry Norris Russell, Ph.D.

THE most interesting object in the skies is still the planet Mars. Though rather far from us—67,000,000 miles at the beginning of March and 85,000,000 at its close—he is very conspicuous to the naked eye, outshining all the stars but Sirius. He is in the eastern part of the constellation Cancer, moving westward ever more slowly until the 22d, when he reverses his course and starts upon a long eastward sweep which will quite encircle the heavens.

Telescopically he shows a disk 14 seconds of arc in diameter the 1st, which shrinks to only 11" on the 31st, as he recedes. Toward the end of the month he will look like the moon about two days before the full, showing thus a conspicuous phase.

The discussion of the surface features of the planet has been revived in the popular mind by his present return to the evening skies, and it may therefore be appropriate to speak of them here.

With a small telescope it can easily be seen that, while the general surface of the planet is of a ruddy hue, there are dark markings upon it which, if watched for two or three hours, will be seen to pass across the disk, carried by the planet's rotation, which is a little slower than that of the Earth. At the pole is a brilliant white spot, the "polar cap," more conspicuous than any other feature. Even with a small telescope the amateur may see that this cap at the present time is steadily shrinking. The north pole of Mars is now turned toward the sun, the season there corresponding to the end of May at the Earth's north pole. By mid-summer from the Martian standpoint, the cap will have shrunk to be only about 200 miles in diameter, if it follows the same law which has governed its behavior with regularity during the past. Towards the end of the Martian summer the cap begins to reappear, first in the form of isolated white patches, which extend till they grow together and cover the surface in a great white sheet 1,500 miles across, which in mid-winter enlarges still only to shrink again with the approach of spring.

It has been observed for many years that, after the polar cap grows smaller, the darker areas of the planet increase in size and depth of color—another clear instance of seasonal change. But public interest is centered not in these conspicuous markings, but in the delicate and elusive ones which are beyond the power of small telescopes to reveal, or untrained eyes to see.

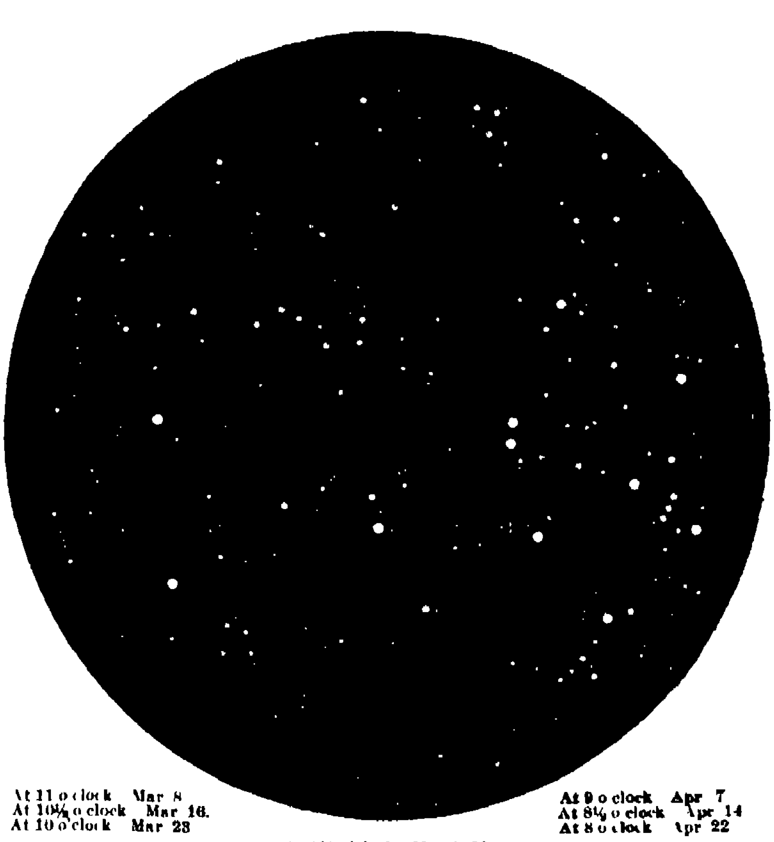
All observers who have studied the planet long, with instruments of sufficient power, and under good conditions of atmosphere, agree in testifying that in the moments when the ceaseless unrest and turmoil of the wind-swept arc through which the rays that reach us must pass subsides, a great amount of fine detail becomes visible on the planet, which, except at these times, is so blurred by the aerial tremors that it can not be detected. Concerning the nature of this detail, however, the reports of competent and skillful students differ widely.

Most widely known, in all probability, are the results of Dr. Lowell, who, during his many years of work in Arizona has consistently seen these markings as fine, sharp, dark lines, traversing the surface, not quite on straight lines, which would be impossible on the spherical surface of the planet, but almost always in "great circles," the shortest and straightest courses possible on a sphere—so that they will merit Schiaparelli's designation of "canals." His drawings too show these lines converging, three, five, or more at once, to definite points, marked often by a small dark spot, or "oasis," so that they form a geometrical network, covering the whole surface of the planet from pole to pole, in the ruddy areas and the dark alike.

It is not so generally known to the public that many other observers, also provided with telescopes of sufficient power for the purpose and experienced in the study of the planet, describe what they see on its surface in quite different terms.

Practically all of them have seen small dark spots, and streaky markings connecting them in some regions of the planet which are clearly the same things as "oases" and "canals." But some of them, notably Prof. Barnard—whose graphic description of the planet's appearance is that it looked like a pinkish globe on whose surface "the dark details had been painted with a grayish colored paint, supplied with a very poor brush, producing a shredded or streaky and wispy effect in the darker regions"—have never, during years of study, seen any trace of a system of fine narrow dark lines. Others, such as Prof. W. H. Pickering and Monsieur Jarry Desloges, who have made extensive series of observations in the last few years, have seen a few narrow straight "canals," but find the great majority to be broader markings, often with diffuse edges, in many cases curved, and in some instances, according to the last named observer, broken up at the moments when the "seeing" was at its best, with a patchwork of finer details which, as soon as the trembling of the air blurred the image once more, merged into an apparently uniform grayish streak.

It is quite beyond belief that, among these numerous observers—some of whom see the canals always as fine lines, others always as diffuse bands, while still others see some in one form and some in the other—only the members of one of these groups have ever seen the planet, during years of observation, well enough to make out the real features of its surface. The explanation must be sought elsewhere, and a clue is given by the one observation in which all students of Mars agree—that the details in question are very elusive, and can be seen only during the moments of good definition and steady images—on good nights only, and even then for but a few seconds at a time.



At 11 o'clock Mar. 8
At 10½ o'clock Mar. 16.
At 10 o'clock Mar. 23

At 9 o'clock Apr. 7
At 8½ o'clock Apr. 14
At 8 o'clock Apr. 22

At 9½ o'clock March 30

NIGHT SKY: MARCH AND APRIL

Even in direct observational matters, such as pressing a telegraph key to record the moment when a star, moving through the field of view of a telescope, appears to cross a fixed thread, psychological differences between observers—known in astronomy by the general term "personal equation" are present and important. If an observer wants to see the star on the "wire" before he presses the key, he will give the signal too late by perhaps a fifth of a second, because the complex processes which intervene in the nerves and in the brain, in such an apparently simple action, will take at least that interval of time. If, realizing this, he tries to avoid this error, and to press the key so that the action shall be completed at the moment when the star crosses the wire, he may overshoot the mark, and form a fixed habit of observing early. By observations on an "artificial star"—a spot of light which is caused, by suitable devices, to move in the field of the telescope so as to resemble exactly a real star—it is possible to determine the amount of this "personal equation" for a given observer, and if, as is the case with an experienced worker, the amount of the correction varies but little from day to day, his observations, after correction for the known influence of this personal peculiarity, can be used with entire confidence, and combined successfully with those of others.

It is very probable that similar principles apply to the far more intricate matter of observations of delicate planetary detail—indeed, there is direct evidence that such is the case, for Dr. Lowell and Prof. Pickering, observing at the same station, and with the same telescope, have consistently recorded the canals, the one as fine lines, the other as relatively wide and diffuse bands or strips.

It seems altogether reasonable to assume that some men's visual and nervous mechanism is so constituted that it reports to consciousness that a faint line, seen by glimpses in moments of good definition, is fine, sharp, straight, and continuous, unless, in these favorable moments, the image presented to the eye is clearly or definitely broad, diffuse, crooked, or broken, while another man's mental apparatus may be so built that, under similar circumstances, it refuses to report a line as sharp, straight, etc., unless, during the best moments, it appears unquestionably and rather conspicuously so.

On a planet whose surface is covered with detail of many kinds, the first observer will see more fine, sharp, straight lines than actually exist there, and the second fewer. Neither one will be at all conscious of these peculiarities on his records, for the psychological processes involved are sub-conscious, and take place automatically, whether the subject is thinking of the matter or not. So when the two observers take pencil in hand to sketch what they see—i. e., what their perceptive apparatus reports to consciousness—the pictures they draw may look very different, though they may be using the same telescope by turns, and be to the highest degree open-minded in all their work.

No other explanation appears to the writer of the present page adequate to account for the facts. If this one be true, it follows that we can not attain certainty regarding the real nature of these elusive Martian markings by any amount of telescopic study of the planet, unless this be supplemented by tests which bring out in some way the nature of the observers' personal equation.

Just as the meridian-circle observer determines this by means of an "artificial star" so the planetary student might well spend a cloudy evening now and then in drawing "artificial planets." These should be disks, roughly resembling Mars in general color and shading, but provided with fine details of the most varied description, of whose nature the observer knows nothing at all until he looks with his telescope at the desk, placed at such a distance that it looks about as big as Mars, and that the effects of atmospheric disturbances of definition are about the same.

If a series of such disks, prepared by a competent committee, could be observed in this way by a number of the most experienced students of Mars, and their drawings collated with one another and with the originals—which, up to that moment, no one of the observers would have seen at close range—the results might advance us far towards a knowledge of the real nature of the planet's finer details. Until such tests have been made, it is unsafe, in the writer's judgment, at least—and, as he believes, in that of a large number of astronomers—to draw any conclusions either from the supposed linearity, straightness, or geometrical arrangement of the Martian canals, or from their supposed lack of these characteristics.

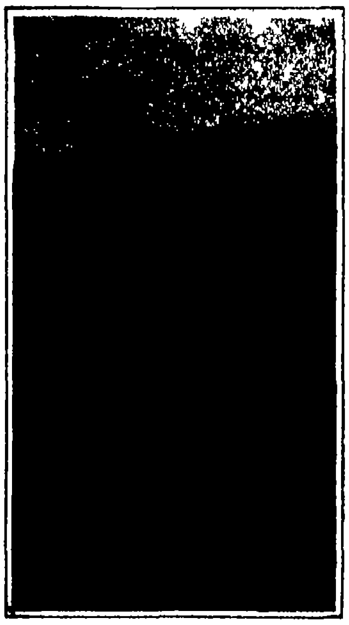
The Heavens

As our map shows, the constellations most nearly overhead on the latter part of the evening are Ursa Major, vertex of the zenith, and Leo, south of it. In the northern sky, below the Great Bear, are the Little Bear and the Dragon, and still lower are Cepheus and Cassiopeia, on the northern horizon. In the south, below Leo, is the huge extent of Hydra, with the smaller groups of Crater and Corvus. Virgo and Boötes are the most conspicuous groups in the eastern sky, while the western is far more brilliant, containing Orion,

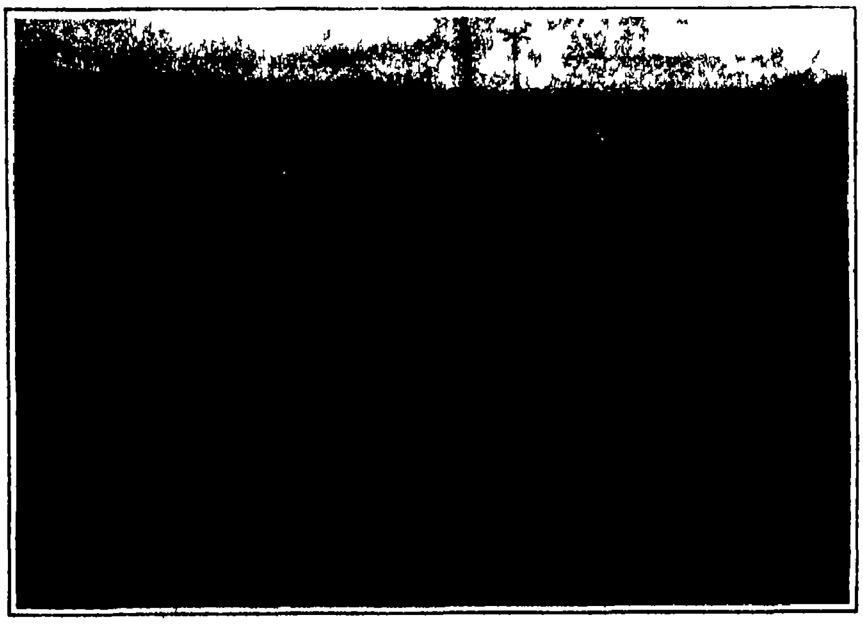
(Concluded on page 266)

Fastening bombs to a Russian aeroplane, preparatory to starting on an air raid

Austrian sharpshooter aiming and firing rifle at an angle using a periscope

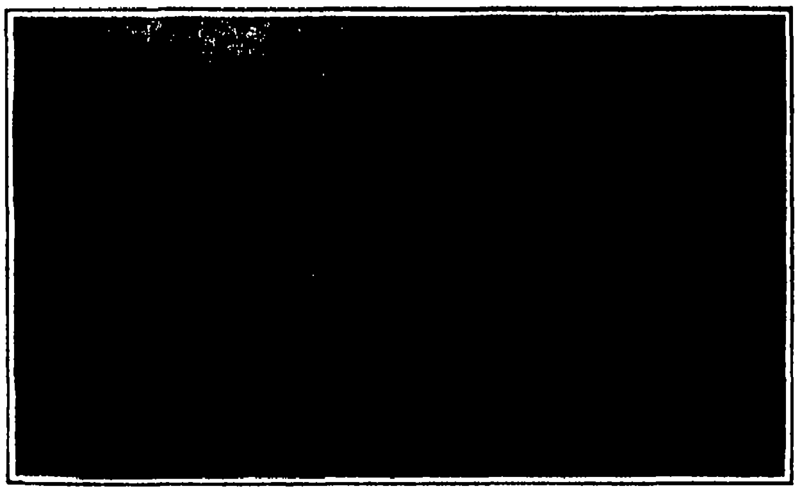


Stretcher used at Gallipoli for removing wounded from the narrow trenches



Post of the commander of artillery in the Champagne district, showing the thoroughness of the defensive works

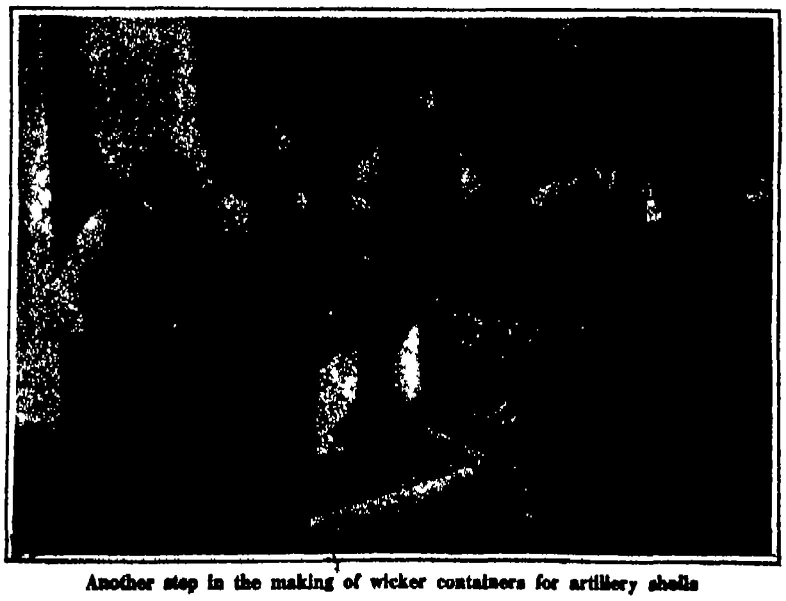
Copper clock weights converted into German shells replaced by stones



"Beehive" car for transporting wounded to the field hospital

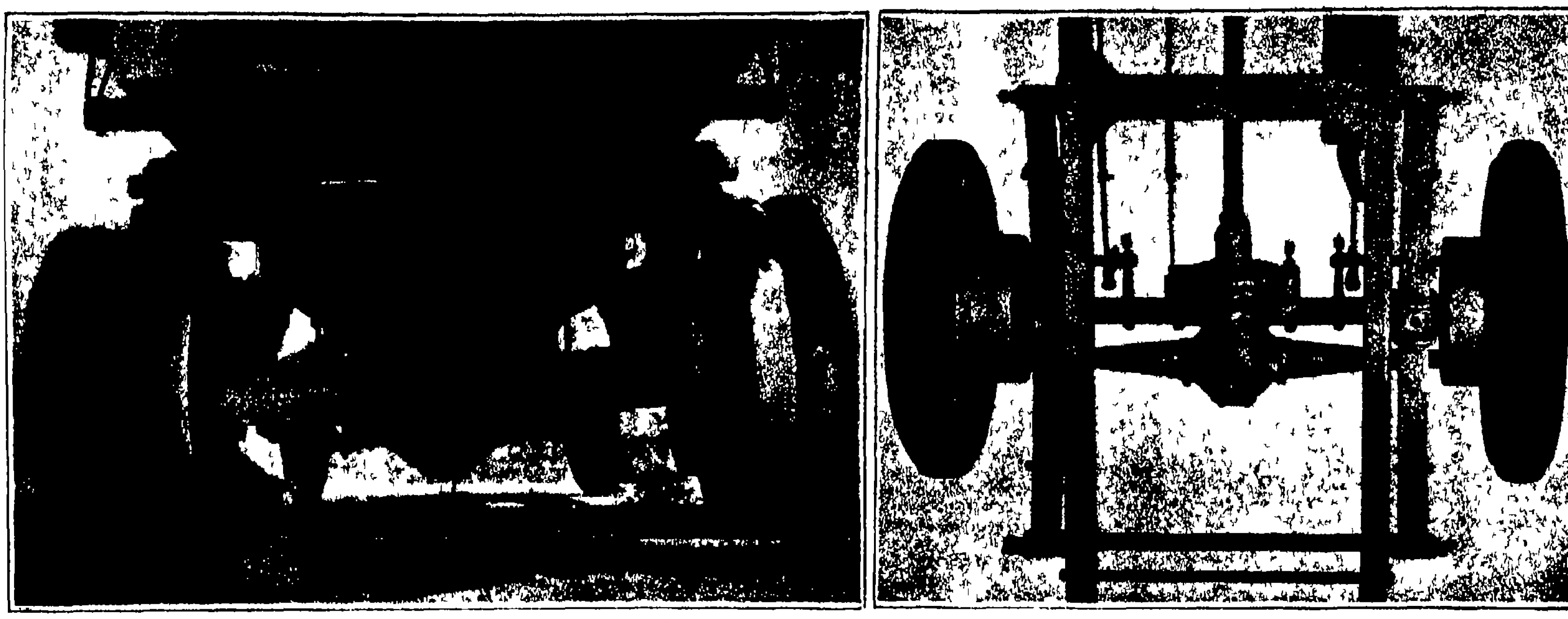
French Alpine soldiers using dogs for transportation of machine guns

German workmen engaged in making wicker containers for artillery shells



Another step in the making of wicker containers for artillery shells

ODDITIES OF THE WAR AS RECORDED BY THE CAMERA



At left. Semi-floating worm-drive axle with driving worm at top of casing. At right: Internal gear drive axle

Features of 1916 Motor Truck Design

A Comparison of This Year's Offerings with Those of Previous Years

By Victor W. Pagé, M S. A E.

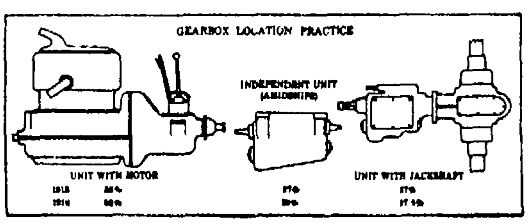
IN the annual automobile number of this journal published the first of the year a brief discussion was presented forecasting some of the features of design that could be expected in gasoline motor truck construction for the coming year. At that time a large number of makers had not given out announcements of their new models so it was only possible to forecast the trend of practice in a general manner. At the present time, however practically all builders of commercial vehicles have furnished details of their product for the coming season so it is not difficult to define the trend of 1916 practice in a more definite manner by giving percentages of increase or decrease for the different structural features. A number of the most striking developments are shown graphically in accompanying diagrams and indicate the progress of design over a period of several years.

Those in the market for commercial vehicles can obtain more for their money this year than at any previous time. The general design of practically all trucks has been greatly simplified as these follow what might be regarded as standardized rules of practice. This is because a large part of the motor trucks offered to-day, with very few exceptions are assemblies of components produced by specialists in their respective lines.

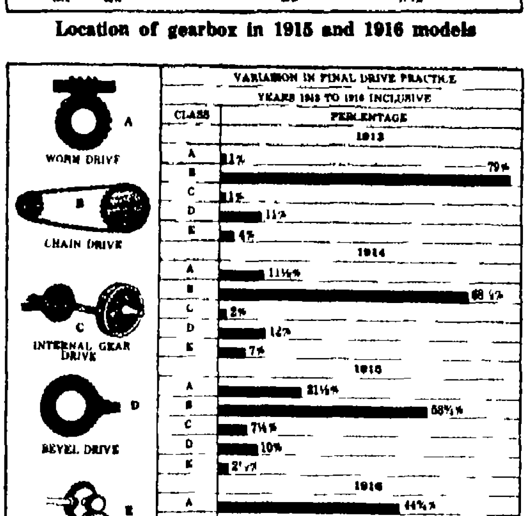
While the prices of trucks have been materially reduced, the quality has been increased, this being due to the simplification of design as well as to quantity production. Last year the average price of a motor truck was somewhere in the neighborhood of $2,500 this being based upon the number of different models offered at that time by the leading makers. The price for the average truck, this year, has been reduced to about $2 250, which is remarkable when one considers the rising price of materials of construction and greater cost of labor owing to reduction in the length of the working day and in many cases an increase in the workman's remuneration which is greater than was formerly paid for more hours of work.

Decline in Light Delivery Models

After analyzing the figures given in a recent issue of one of the well established motor truck papers *The Commercial Vehicle*, which have been based on painstaking computations extending over that period of years covering the most important developments in truck design one can outline the trend of present-day practice in an authoritative manner. The first thing to consider is the variation in carrying capacity of the models offered for a number of years. One notes that most of the makers favor trucks of about 4,000 pounds load rating this year. There is a marked decline in the number of light delivery models of less than 1 000 pounds capacity. In 1913, 13 models were offered the next year the number had increased to 15, and in 1915 there were 19 light delivery wagons available. This year there are but 8 listed. Nineteen models of 1 000 pounds capacity were marketed in 1913 28 in 1914 31 in 1915, and the number has been reduced slightly to 28 for the coming year. The number of models in the 1 500 pounds class has not varied much though fewer models are available this year than last. In 1913, 47 models were built the next year one more maker added a 1,500 pound truck to his line. This high point of 48 models was reduced to 44 in 1915 and 40 in 1916. The year 1914 was also the banner year for the one-ton truck, as there were 72 models available as compared to 59 models of the year previous. Last year there were 68 trucks of this capacity, this year there are but 65 models listed. The year 1915 indicated the high point in number of 1½ ton models as 66 of this type were then obtainable. This was an increase of 16 over the number marketed in 1914 and of 20 over the 1913 figure of 46 types. This year 54 models of this capacity are available.



Location of gearbox in 1915 and 1916 models



Variation in final drive practice in motor trucks

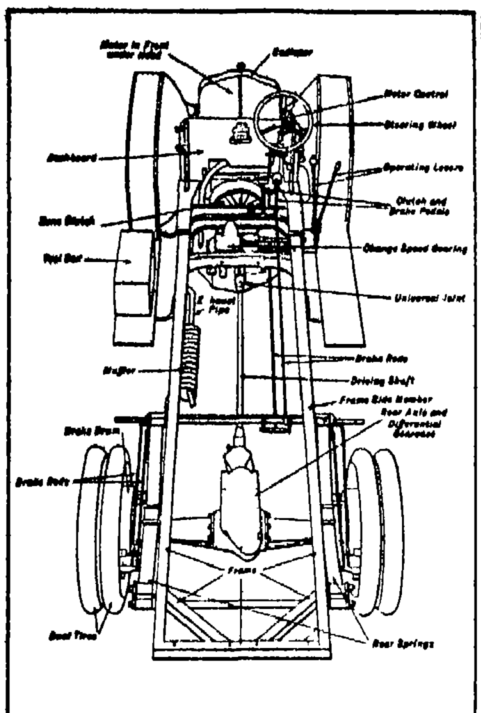
For two years 1913 and 1914, there was no increase in the number of 4,000-pound trucks, the figures remaining at 62 models for each of those years. Last year there was a marked increase to 76 models, this year the number has been further augmented, so 93 2 ton models are manufactured. There has also been an increase in the number of trucks of 5,000 pounds capacity. Five models of this size were listed in 1913, the number doubled in 1914, the year following it was nearly four times as large as in 1913 as the number increased to 19 models. There has been a slight decline to 17 models this year. A gradual decline has been noted in the number of 3-ton, or 6,000-pound models. In 1913 55 were listed, the next year the number fell to 48 in 1915 to 43 and this year even a sharper decline is noted as only 33 models are announced. The 3½ ton truck was made in 14 models in 1913 and 1914, the number increased to 28 in 1915 and is now 38 models. The 4 ton truck is an odd size, because very few people would have use for a truck of this capacity that could not use the next larger, or 5 ton type to equally good advantage. We find 19 models listed in 1913, 17 in 1914, 16 in 1915, and 14 in this year's list. The number of 5-ton models has not varied as much as some of the smaller trucks, though fewer models are made this year than in the past. In 1913 there were 49 makes, in 1914 the number was reduced to 44 models. Last year the number increased to 45, this year it has declined to 43 models —not a very pronounced variation.

The makers of trucks have discovered a falling market for 6-ton trucks because the number of models is less than last year. In 1913 nine models were marketed a year later the figure was increased to 16, this was augmented by two more models in 1915, and has fallen off to 14 models this year. Of larger models, including the 7 ton capacity and over, the limited demand for these sizes is well exemplified by the small number of models available. There were 6 makes of these large trucks available in 1913, 8 in 1914, 12 in 1915 and but 10 for 1916.

Characteristic features of a 1916 motor truck

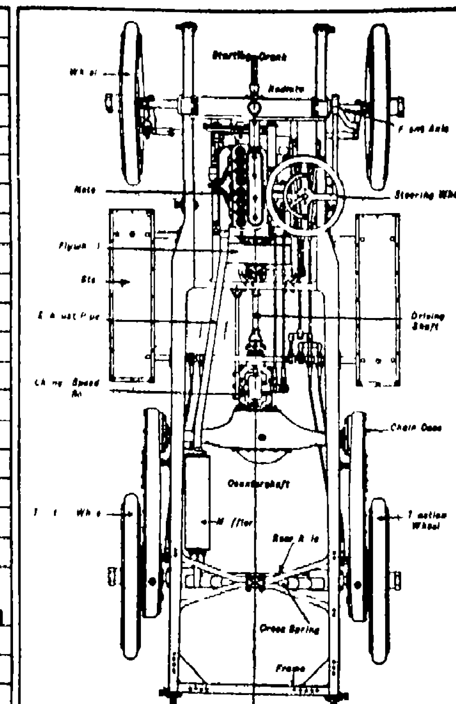
Lowering of Prices; Increasing of Values

Considering prices, the average cost of a smaller truck than one-half-ton capacity in 1915 was $480.50. This year it is $429 17. The price of a 1,000-pound truck was $862.77 in 1915, this year it is $766 48. The cost of 1,500-pound models has been likewise reduced from $1,329 to $1 234. The reduction is not so marked in the 1 ton class, the 1915 price of $1,661 having diminished but little as it is $1,642 this year. The average one-and-one-half ton truck sold for $2,057.50 last year, this year it is priced at $2,004. The increased production of 2-ton trucks has resulted in a substantial reduction this year, the figure of $2,288 being considerably less than the 1915 charge of $2,434. A decrease of about 9 per cent



EXAMPLE OF CHASSIS CLASS A

VARIATION IN ENGINE LOCATION PRACTICE YEARS 1913 TO 1916 INCLUSIVE	
CLASS	PERCENTAGE
	1913
A UNDER HOOD	65%
B UNDER FLOOR	30%
C BETWEEN SEATS	3%
D UNDER SEATS	2%
	1914
A	52%
B	30%
C	15%
D	3%
	1915
A	77%
B	14⅝%
C	5%
D	3⅛%
	1916
A	86%
B	5⅛%
C	4⁷⁄₁₀%
D	3⁹⁄₁₀%



TYPICAL CLASS B CHASSIS

Variation in engine location practice in 1913, 1914, 1915 and 1916 motor truck models

is found for the 5 000 pound class. In 1915 these sold for $2 740 this year the average price is $2,481. Three-ton trucks now sell for $3,147, last year they were priced at $3,271—not a very great reduction as it is only about 3 per cent The reduction in price of 3½ ton trucks is greater, the difference between the 1915 and 1916 prices being $213 or 6 per cent reduction. Last year's average for this size was $3,489, this year's price is $3,276. The 4 ton truck has not been reduced in price this size costing about 2 per cent more this year than last. In 1915 the price was $3 337, this year it is $3,417 or an increase of $70 There has been practically no reduction in price of 5-ton trucks, in 1915 they sold for $4,312, while this year the average is $4,311 Six ton capacity trucks now sell for $4,555, a reduction of $359 from the 1915 price of $4,915, this representing a reduction of 7¼ per cent The average price of trucks over 6 tons capacity has been increased 6 per cent, the 1915 figure of $4,394 being increased this year to $4,687

Engine and Drive Details of Present Models

The most marked development has been the practically general adoption of the European type of construction in which the power plant is mounted at the front of the chassis under a hood. In one of the accompanying illustrations are shown the variations of engine location practice for the years from 1913 to 1916, inclusive

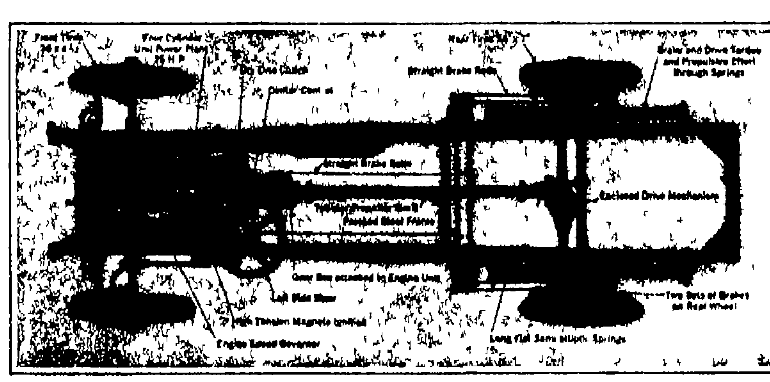
The truck frame construction has been considerably simplified because of the wide adoption of the Hotchkiss drive and of rear axles in which the drive gearing is entirely enclosed In fact, a pronounced tendency is noticed in the great increase of worm gear drive The variation in final drive practice is clearly outlined in an accompanying diagram which covers a period of years from 1913 to 1916, inclusive

A consistent increase is noted in the internal gear drive principle, this not being as marked as that of the worm drive but showing that truck makers were forced by public demand to use those types of rear axles that were most efficient and in which the drive gearing was completely enclosed The falling off in the number of cars equipped with bevel gear drive is due to the lessened use of pleasure car types for motor truck purposes

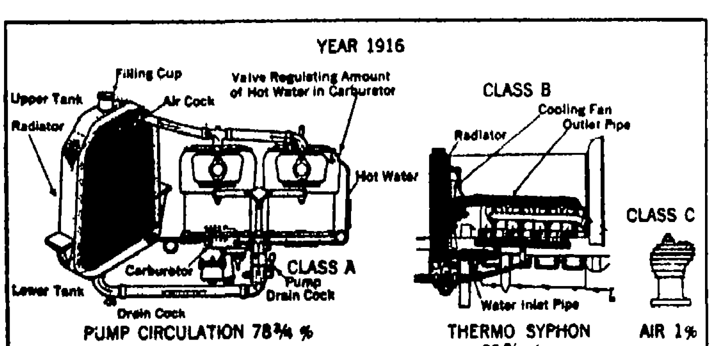
The greatly reduced percentage for the double reduction drive which is but one

(Concluded on page 263)

Side view of typical truck design for 1916, showing simple chassis construction made possible by the use of shaft drive axles and elimination of radius rods and torque members

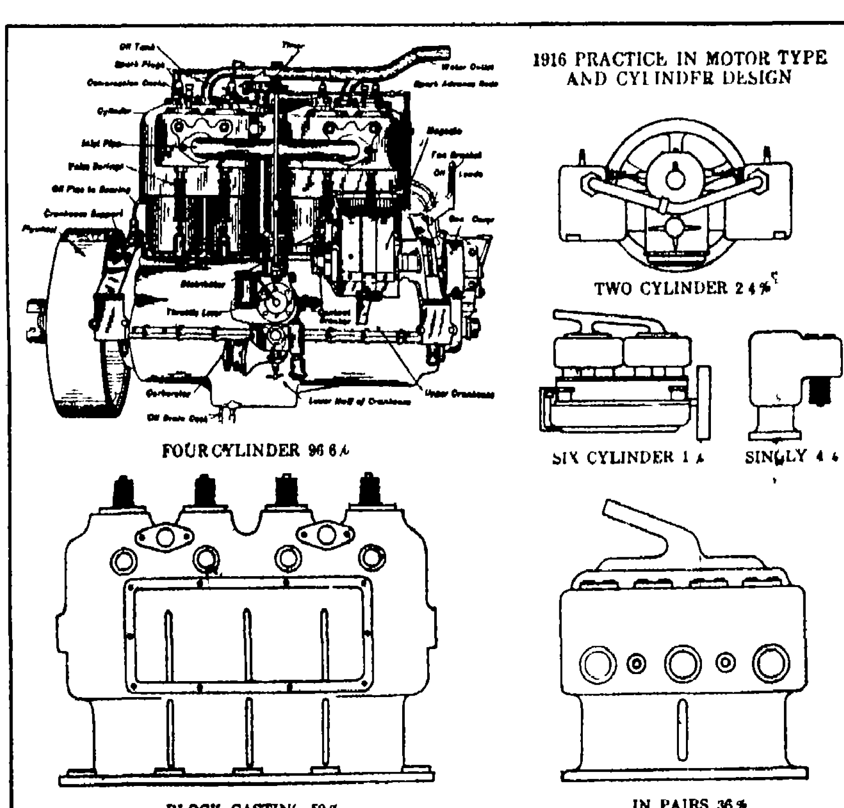


View looking down on a typical 1916 model truck chassis

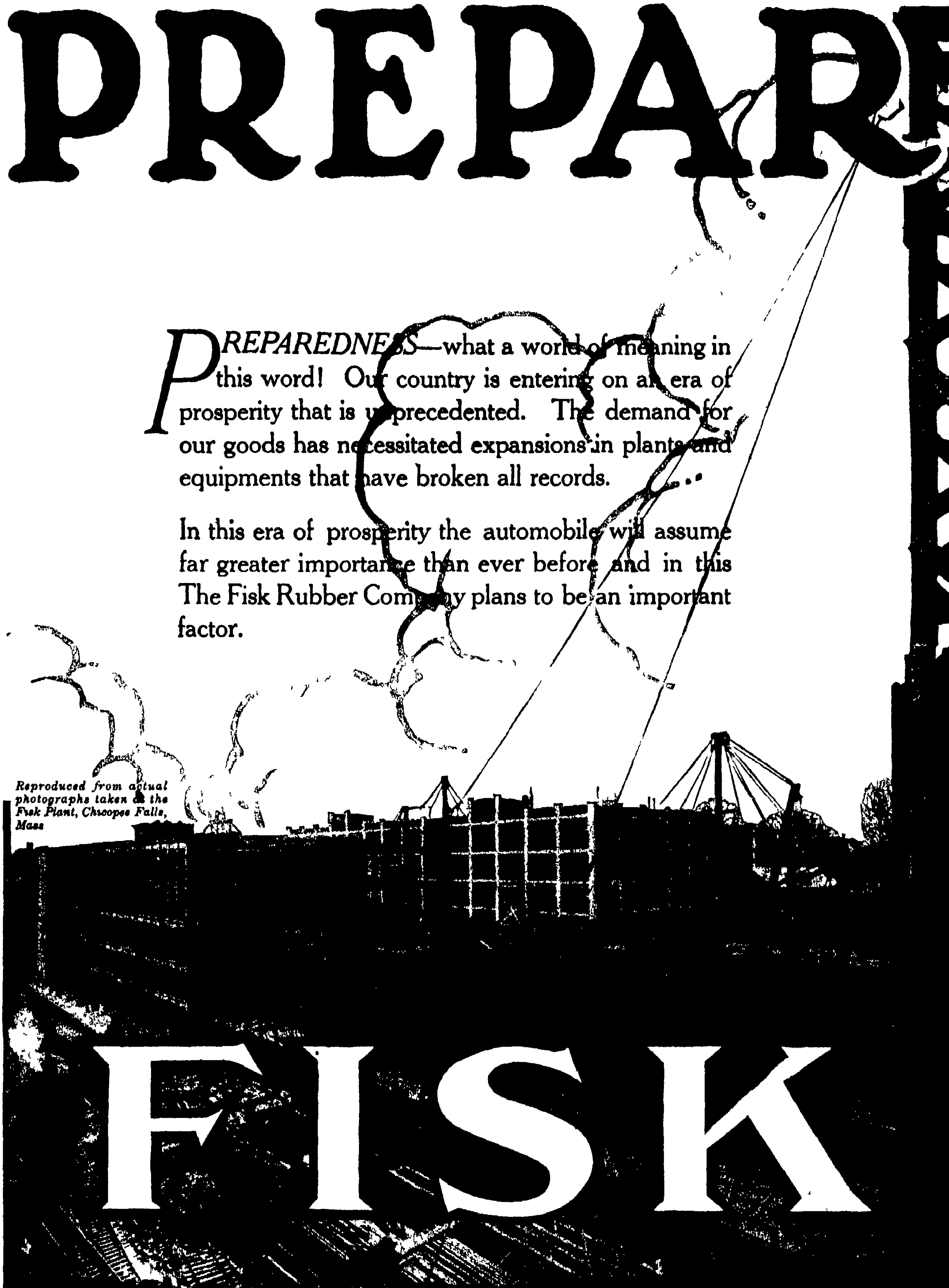


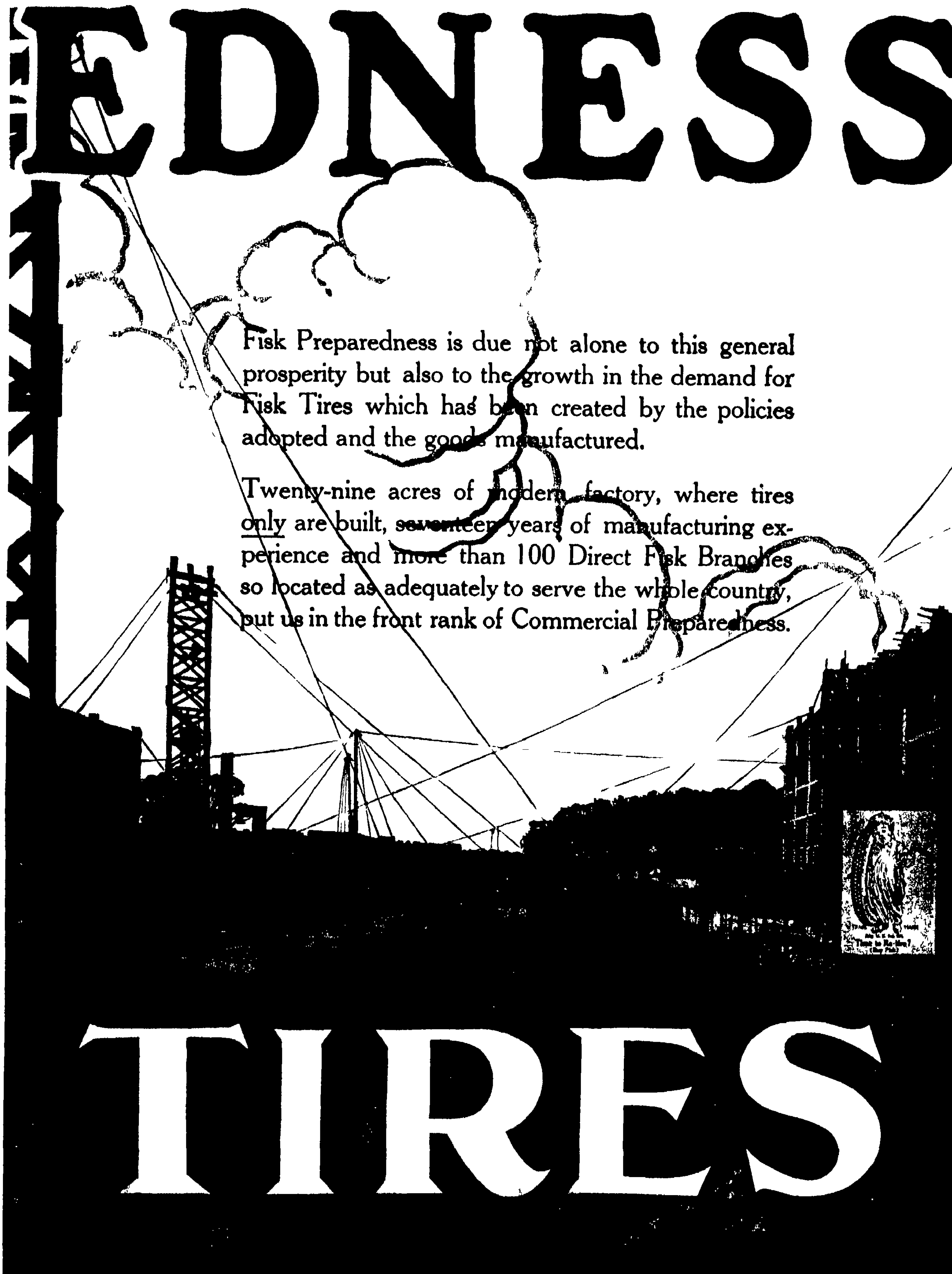
VARIATION IN ENGINE COOLING PRACTICE YEARS 1913 TO 1916 INCLUSIVE	
CLASS	**1915**
A	81%
B	17⅘%
C	1¼%
	1914
A	68%
B	26%
C	6%
	1913
A	65%
B	23%
C	12%

Variation in engine cooling practice



Motor and cylinder design practice in 1916 models


PREPAR
PREPAREDNESS—what a world of meaning in this word! Our country is entering on an era of prosperity that is unprecedented. The demand for our goods has necessitated expansions in plants and equipments that have broken all records.
In this era of prosperity the automobile will assume far greater importance than ever before and in this The Fisk Rubber Company plans to be an important factor.
Reproduced from actual photographs taken at the Fisk Plant, Chicopee Falls, Mass
FISK

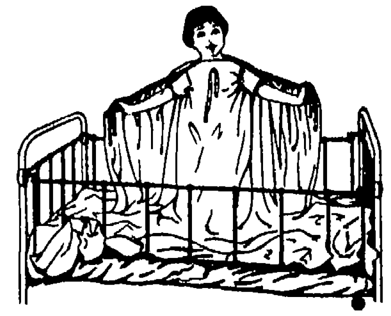

EDNESS
Fisk Preparedness is due not alone to this general prosperity but also to the growth in the demand for Fisk Tires which has been created by the policies adopted and the goods manufactured.
Twenty-nine acres of modern factory, where tires only are built, seventeen years of manufacturing experience and more than 100 Direct Fisk Branches so located as adequately to serve the whole country, put us in the front rank of Commercial Preparedness.
TIRES

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

SLEEPING GARMENT — FLORENCE J BLENIS Valhalla N Y This invention provides a garment especially adapted for use upon infants while sleeping the garment being



SLEEPING GARMENT

provided with means for preventing its displacement with relation to the bed or the wearer The intention is to securely fasten the bed coverings to the person of the child, so that while freedom of motion is assured it is impossible to kick off the coverings or to get out of bed

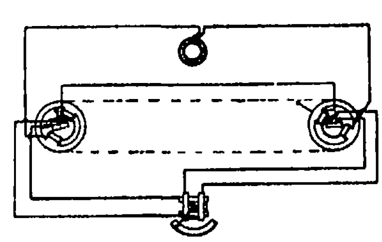
RETAINER FOR HAT PROTECTORS — J W JACOBS, 6 Willow Place, Far Rockaway L. I., N Y The main object of the invention is to improve the means for temporarily holding or supporting the protector within the crown of the hat in such a manner as to be readily and quickly removed for application when required in the case of a sudden shower for instance

WASHABLE CORSET — Y SAYNISCH, 325 3rd Ave, New York, N Y In the present invention the improvement has reference to washable corsets and the object thereof is to provide a simple inexpensive and sanitary corset which will be provided with removable corset steels whereby the fabric can be washed as any other garment

Electrical Devices

ELECTRIC RAT AND ANIMAL TRAP — O WEISS P O Box 768 Butte Mont The invention provides a device having a hinged portion which will move under the weight of the rat or other animal so as to connect the primary of an induction coil the movable part being so constructed that the animal will come in contact with oppositely charged portions connected up with the secondary in such a manner that death will result

RANGE FINDER — A M KENNEDY, Edison Laboratory, Orange N J The salient features of this range finder are the long base gives accuracy direct reading avoids time lost in



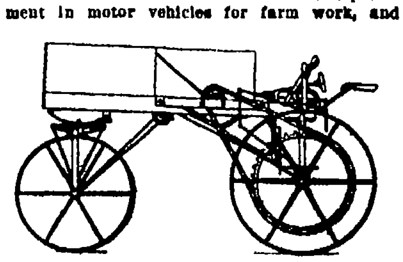
RANGE FINDER

computing the range from the angles read readings independent of wattage or frequency of source or resistance of circuit render these readings accurate though the speed of generation or conduction of the line should change

Of Interest to Farmers

CHECK ROW ATTACHMENT FOR PLANTERS — W JELSEMA, R F D No 2, Sioux Falls, S D The invention provides an attachment that may be applied with facility to standard makes of planters provides for making quickly and with facility, the necessary adjustments in the attachment, whereby to time the dropper elements at the beginning of successive rows to accord with the positions of the hills in preceding rows.

MOTOR VEHICLE — E L. FOLSE and S. E. ROBICHAUX R F D No. 1 Box 16 Raceland, La. In this case the invention is an improvement in motor vehicles for farm work, and



MOTOR VEHICLE FOR FARM WORK

has for its object the provision of a simple inexpensive vehicle of the character specified, having means adapted to support cultivating mechanism, and adapted to be driven by the same motor that drives the vehicle.

Of General Interest

GROMET — W. A. YOUNG, 198 Eleventh Ave., Astoria, New York, N Y The invention provides an article having even resistance throughout, simplifies the construction of devices to reduce the cost of such construction, and provides an article having structural, grouped packing members of different thicknesses for utilization in different ways.

FOLDING PACKING BOX.—A. MISROCH and A KAHN, 291 Grand St., New York, N Y This invention has reference to packing boxes of that type which are folded from flat blanks into box form when desired for use, and the invention has to deal more particularly with a closing or locking means for boxes of this character

PIPE COUPLING.—E J MAIRÉ, Lima, Ohio This invention is more particularly intended for gas lines but may be employed for connecting pipes generally for conveying oil, water or other fluids. An object is to provide a coupling which may be readily applied to the plain unflanged ends of pipe sections and insure a fluid tight joint.

NURSERY RATTLE.—AMELIA MORSE, Nursery Novelty Co., 32 Union Square, New York, N Y This device is of an unusually pleasing appearance and is provided with several parts adapted to move relatively to each other around a common axis, one part being within the other and provided with a plurality or series of illustrations adapted to be viewed in succession through one or more windows formed in or through the outer part.

BILL FOLDER — E P O'HARA, care of John Mehl & Co, Jersey City N J This invention provides a folder which is characterized by the provision of a central slit on the outer surface thereof where through bills are entered into the folder and a cut-out covered by a flap on the inner surface of the folder where through bills can be extracted with great ease

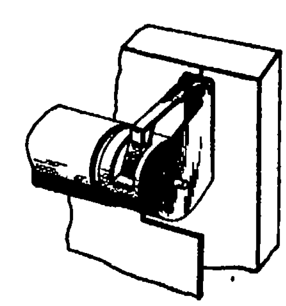
METHOD OF MANUFACTURING DEHYDRA ZINC SULFID — C RANSON, 2 Rue Poncelet, Paris France In carrying out the process the resultant product is freed from flourin compounds by washing in water If hydrochloric acid has been used an alkali or alkaline earth must be added to the washing water for the purpose of eliminating the whole of the chlorin which is present for the most part as zinc chlorid

Heating and Lighting

PORTABLE ELECTRIC LAMP — J L. STRAUSS 532 E 88th St, New York, N Y The invention provides a lamp having a flexible connecting wire with means for automatically and at will gathering a portion of said wire provides a gathering mechanism for electric lamp cord said mechanism being adapted to wrap said cord in a coil of small compass, provides a lamp having a hinged standard rotatable to carry the plane of the swing of said standard, and provides electric current connections disposed in a supporting base to permit independent movement of the lamp supporting standard

Household Utilities

SHADE ROLLER — D A LANE care of Edwin H Yelser Suite 810 Littlefield Bldg, Austin Tex. Window shades are generally



SHADE ROLLER.

very insecurely fastened to their rollers, and often times by pulling a shade full length it is sipped or torn from the roller, thus necessitating either the purchase of a new shade and roller or the expenditure of time and labor in repairing the torn shade and securing it to its roller

SASH WEIGHT MOLD — S. J SULLIVAN, P O Box 298, Hot Springs, Ark. This invention provides a mold adapted for permitting the simultaneous casting of a number of weights, each of the desired shape and size, and provided with the eye for the passage of the cord, wherein the mold is so arranged that it may be heated or cooled during the operation of molding and wherein air vents are provided for preventing the formation of air bubbles, flaws and the like on the cast article.

SASH WEIGHT MOLD.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Economic Preparedness

(*Concluded from page 237*)

of our size and need and opportunity To increase the yield of our farms and to give us an independent and adequate supply of nitrogen for the explosives used in war, we must set water wheels at work that will fix nitrogen in lime

Two resources of little or no value alone, but together constituting wealth, we have in abundance Land without water is not available for agriculture, water, master and not servant, destroys property, industry, wealth and lives.

Many rivers, great potentially as sources of irrigation, in periodical overflows and floods do incalculable damage When we have conquered our rivers and made them serve by spreading out at our will, not theirs, over the land we wish to make blossom under the beneficent influence of irrigation, we will have added to our national preparedness a factor the value of which cannot be computed

No one can take the yearly toll of lives lost and property destroyed by the furious and unrestrained sweep of our rivers without realizing that the people of this country cannot regard themselves as owning this land, really possessing it until they have brought these waters under subjection. And in doing this they will literally create new land by the millions of acres, lands that will support millions of people as against the thousands which live upon it to-day And in saying this I am not speaking without authority, for a year ago we enjoyed the value of a visit from the renowned builder of Assonan Dam Sir William Willcocks, who has spent his life in India, Mesopotamia and Egypt, as a river tamer And after he had seen our problem he sighed with regret that it might not be his fortune to see the day that he said would surely come when the valley of the Mississippi would be another valley of the Nile, only greater in area and more perfectly adapted to the white man's life This is the largest task that the Government must undertake sooner or later and the sooner, in my judgment, the better

How these great works can be carried on calls for constructive thought, not merely on the engineering side but more immediately upon the financial side as to those ways and means by which the lands reclaimed shall be made to bear in some degree the burden of the expense As to the funds which will be needed, they mount into such figures as to be staggering And I can see no hope that this work will be adequately undertaken without the Government advancing its credit and investing directly some of its own funds. We are conducting this government from day to day out of current revenues Only the richest of people could pursue such a policy No private enterprise attempts it. No railroad system has been built that way But few of the states now construct their highway systems out of the year's revenues The permanent improvements which the whole people undertake are a legitimate charge against capital account, not against maintenance A commission to devise the ways and means by which the states and private land owners and the National Government can cooperate in paying for the work done seems to me a more needed body than one which will report upon engineering methods.

There are other sides to the question upon which I have not touched the conservation and development of our twenty two millions of children, the men and women of to-morrow, the proper use of our forest reserves and the wise enactment and administration of laws regarding timber as well as minerals, the commercial development of the incredibly rich territory of Alaska without its exploitation for the benefit of the few, the broad visioned development of inland waterways and rivers for commerce, the problem of good roads, which the automobile, and especially the automobile truck, is gradually working out.

But enough has been said to indicate that no country in the world has better material with which to work. I believe that conservation, in its broadest term, means not the mere saving of a resource against the possible future need, but making of the conserved resource as widely useful to the greatest possible number in the shortest possible time consistent with the elimination of waste. It is along this highway that this nation must move, in my judgment, if it is to be economically, commercially, humanely prepared for any future, whether of peace or war, which is to be commensurate with the opportunities nature has given us, and worthy the American character

The American Conquest of the Air

(*Concluded from page 247*)

195 000 tons Our coke plants allowed about 600,000 tons, worth over $38,000,000, to go to waste! Germany, the leading producer of ammonium sulphate, reported 604 000 tons as her output for 1913

Much of our arable territory still depends upon nature's mechanism for maintaining a minute fraction of the nitrogen present on our globe in the active service of the animal and vegetable kingdoms. This small amount about two one-millionths of the entire supply of nitrogen, is largely in the soils in the form of nitrate. It is a chief factor of plant food With the plants it passes into the bodies of animals, whence it returns to the soil Through the action of certain bacteria, a slight portion reverts to the elementary form of atmospheric nitrogen. Through the action of other bacteria with the aid of certain legumes and by electric discharges in the air a corresponding amount is constantly brought into a combined form and enters the cycle of charges On an average, about two-thirds of one ounce of this "nomadic" nitrogen, as it has aptly been termed, is present in each square yard of land

Prior to this age of dense population in many countries nature's adjustments proved ample for insuring an adequate food supply Now it is an imperative necessity in many regions to treble and quadruple the weight of grain or of vegetables obtainable from a given area To this end plant life must have an adequate ration of combined nitrogen, accompanied by the requisite amounts of potash and phosphoric acid This ration may be in the form of nitrates or of ammonium compounds Cyanamid naturally falls into the latter category

The world's supply of coal is not inexhaustible The day may arrive when coal will be a precious commodity Some countries are totally lacking in coal

For the time being the regions in which intensive agriculture is practised have depended largely on Chile saltpeter for their supplies of combined nitrogen The deposits in Chile are however, distinctly limited This century may witness their total exhaustion

Farsighted economists feel, therefore that the time has come to profit from nature's example, and to establish upon a large scale the technical transformation of atmospheric nitrogen into a combined form

Electricity is essential in two of the technical methods found susceptible of industrial application The first depends upon the interaction between pure nitrogen and calcium carbide, at a somewhat elevated temperature. The product is cyanamid. The second method is based upon the exposure of air in a rapid current, for an instant, to the very high temperature of the electric arc Nitric acid is the direct product. For fertilizing purposes it is usually changed into the form of the calcium salt.

The latter method is exploited on a grand scale in Norway, where hydroelectric power is exceedingly cheap—$3.00 per horse-power annually There are small plants at several points in Austrian Tyrol and in the French Alps.

The manufacture of cyanamid is pursued regularly in Germany, Austria, France, Italy, Switzerland, Norway, Sweden, and Japan. The only factory on the American continent is at Niagara Falls, Ontario, to which reference has already been made. In the fifteen existing works there is an annual production of 338,000 short tons.

The synthetic production of ammonia

by Haber's method, based upon direct action between nitrogen and hydrogen, at a temperature of 500 degrees C., under very high pressure, has not been attempted outside of Germany

Coming now to the feasibility of establishing upon American soil the fixation of atmospheric nitrogen on a grand industrial scale, it is to be noted that we possess the requisite water power to an extent but remotely approached in Europe.

The present consumption of nitrogen compounds is large the prospective consumption will be enormous

Historically, American inventors blazed the trail for the introduction of the electric synthesis of nitric acid from the air, when Bradley and Lovejoy, in 1902, erected their plant at Niagara Falls, New York. Technically it was a success. Financially the venture was a failure.

And now in 1916 this country is with out a single factory of industrial rank occupied with the fixation of atmospheric nitrogen We still pay the heavy tribute to foreign producers of nitrogen in a combined form We are still exposed to the dangers of wide spread disaster for a multitude of interests should communication with Chile be severed. We still fail to recover the 600 000 tons of ammonium salt allowed to go to waste in our coke plants.

Is not the time ripe to consider among our plans for "preparedness" adequate measures for rendering our nation s industries and our nation's munition plants absolutely and permanently free from this ignoble dependence upon the one source under the Southern Cross, scientifically of such fascinating interest, geographically so distressingly remote?

Shall we still lag behind while Japan, Switzerland and Scandinavia offer to us examples of how nations can create the industries vitally necessary for economic and military independence and defense?

There are rays of hope Ambitious plans seeking to create in North Carolina a plant on a generous scale for the fixation of atmospheric nitrogen were formed some years ago, and the initial steps undertaken The foreign capitalists in control of the fine water power involved have finally abandoned their half hearted attempts The property has passed into the hands of a prominent and forceful American capitalist and manufacturer under whose guidance the long-delayed project may be revived and brought to early completion

In a wild valley of a western state alongside a picturesque waterfall, a purely American solution of the problem of con quering the air has also recently been worked out on a fairly adequate industrial scale It appears of much promise to those familiar with the details

In the most diverse quarters deep interest is being manifested in the question as one of pressing and paramount importance

I can but hope that simultaneously with the creation of an American dyestuff industry and the evolution of an American potash industry, we may witness the triumph of American skill and enterprise in perfecting the conquest of the air in transforming the invisible medium in which we live and breathe into one of the most useful and most important factors of the country's comprehensive and self contained chemical industry

Commercial America and the War

(Concluded from page 241)

own optical glass, our own chemical porcelain our own photographic materials, our own china, our own brushes, our own scientific apparatus, our own souvenir postcards, etc. We must utilize more and more of our own raw material. We must send less cotton abroad to be manufactured We must send less wheat abroad and more flour We must send abroad less of the raw materials and more of the finished manufactured products. We must make our plants more efficient, so that we may more effectively compete with our European competitors in our own markets and in neutral markets and in their own markets. We must introduce more labor-saving machinery We must educate our workers to higher standards of technical skill. We must

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eliminate the unskilled and find and train the skilled. We must make our whole industrial organization more efficient and more economical. We must have confidence in ourselves and in our ability to compete with the other countries of the world.

But the crux of the whole matter lies in our foreign trade. It was our foreign trade which was interrupted at the beginning of the war, and it was in our foreign trade that we experienced the most serious economic effects, effects which for a time seemed likely to bring about the most serious economic consequences. The war indicated in unmistakable terms that our domestic prosperity is vitally linked up with the prosperity of our foreign trade We found what to many of us was astounding, and to some unthinkable, that a small segment of our total business, very small when compared to the vast amount of our total trade, held the key to our prosperity

Factors on Which Success in the Coming Commercial Strife Will Be Based

Our success in foreign trade in the future and in competition with the nations of Europe will rest on certain elemental factors

(1) The first and most important factor is men We must find a supply of trained men who will be able to carry on our foreign trade Such a supply of trained men does not exist to-day We must, therefore, find means of training men for foreign trade We must have men who not only know business, who not only know their particular business who not only know foreign languages, who not only are able to sell goods, but men who are able to go into foreign markets with a sympathetic point of view and represent American manufacturers as they should be represented In foreign trade we need business diplomats

(2) The second factor in the success of our foreign trade is our ability to finance foreign trade By financing foreign trade I do not refer merely to the extension of credits, or to the establishment of branch banks or to the discounting of paper, but I refer to the whole mechanism of foreign exchange, a mechanism with which the average American business man or the average American banker knows very little, and I refer to what is even more important—that is, the investment of American capital in foreign countries It will not be possible for us to get foreign trade in any large way until we have provided the funds with which to build railroads, docks, public utilities, factories, mines, warehouses, and the other public improvements in which capital must be invested

(3) The third element in a successful campaign for foreign trade is the establishment for this country of a conventional tariff system For the very reasons which I have already pointed out, it is impossible for the United States to maintain an isolated economic position. We inevitably have certain relations with other nations. We import their commodities and we export our commodities Many nations are able, by means of their tariff systems not only to prohibit the sale of or to handicap the importation of commodities from nations which may be economically unfriendly, but they are also able to encourage the exportation of their own commodities by advantageous bargains with countries which are economically friendly The conventional tariff system means a tariff system with an international point of view It is the kind of a tariff system which because we lack that international point of view, we could not have up to the present It is the kind of a tariff system which, with the present enlightened administration of our foreign affairs and with the intelligent interest in our commerce that is being taken by Congress, we can now have.

(4) In the fourth place, we must prepare to become the market place of the world for certain staple commodities. In spite of the fact that we have consumed about half of the world's output of crude rubber, we have imported a large part of that rubber from England. In spite of the fact that we have consumed over one-third of the world's total output of tin, we have never smelted any tin, and we have purchased it from Europe. In spite of the fact that we are the largest consumers of wool in the world, we have purchased more than half of our imports from England. In spite of the fact that we are the largest producers of cotton in the world, we have permitted certain European middlemen to handle a goodly proportion of our output of cotton. We must be prepared with all the machinery of an international market to handle these world supplies. We must have at our important markets the machinery for handling these commodities. We must have ample warehouse facilities We must be able to handle the commodities economically We must be able to grade the articles. We must have exchanges where they can be readily bought and sold We must have arbitration committees for the settlement of disputes between sellers and purchasers. All of these things must be done before we can take our place as the leader of the world's commerce

(5) The final factor in the development of our foreign commerce is the necessity of an American merchant marine American capital, for one reason or another, has been reluctant to enter this field of economic endeavor We have frequently heard that our navigation laws are antiquated and operate to the disadvantage of American boats Yet recent investigations have disclosed the fact that there are no important differences between the laws of the United States and those of other countries having large merchant marines It is high time that private capital went into the business of supplying the United States with a merchant marine If private capital is not willing to go into that business, and to go into it quickly, the Government should come to the aid of our manufacturers who wish to export their commodities under conditions which are substantially equal to those of their competitors We should not be left at the mercy of other nations who may wish, from whatever motives, to prevent the exportation of American goods to foreign countries and to control the marketing and handling of these commodities

What We Have Accomplished in Preparation for Peace

Let us take a brief account of stock The United States has made some preparation for peace, and there are other preparations planned and under way

(1) Under the Federal Reserve Act and with the creation of the Federal Reserve Board, our financial resources are for the first time in our history mobilized for foreign trade The creation of a discount market and the establishment of branches of national banks in foreign countries are new tools invaluable in our campaign for foreign trade, as well as in preparation against difficulties at home

(2) The creation of the Federal Trade Commission opens up another avenue of approach to the goal of a better and a bigger business. It is to the Federal Trade Commission that we look for guidance and advice in the matter of combination for foreign trade, and it is to that body that we look for protection against international unfair competition The Trade Commission is also prepared to set our domestic business right and to lay down the rules of the game We all look forward hopefully to the results which this Trade Commission will obtain in making the conditions of business in this country more stable and more certain, and hence better prepared.

(3) Definite constructive work in advancing our trade frontiers is being done by the Bureau of Foreign and Domestic Commerce. The chief function of that Bureau is to promote our foreign trade The actual practical results, too numerous to mention, are the best tests of the success of its work. The Bureau collects information about foreign markets for American goods. This information comes from the consuls, from the commercial attachés, and commercial agents. The office in Washington is the warehouse or distributing depot, and the staff there and in our branch offices is a selling organiza-

tion, a selling organization engaged in selling that information for action. Action is the price, and results are the objects of our work. We have asked Congress for a large additional appropriation, in order to put our equipment in this respect on a par with that of the other great countries of the world.

(4) Now we come to two arms of our service which do not exist, but which, if you, the public, and Congress, your representatives, desire, will soon come into existence. The creation of an expert and practical Shipping Board will do much to make possible the establishment of a merchant marine for the United States. The first and primary function of this Board is to discover what needs to be done, and the second is to do it. Large powers are to be entrusted to the Board, powers which even compass the purchase and operation of vessels. These are powers, however, which are to be used only in case of emergency, and only when the establishment of a merchant marine can be attained in no other way The establishment of a Federal Shipping Board is a very important part of our preparation for peace, and one which we cannot safely delay

(5) If it is true that we are no longer an isolated nation, capable of living for and within ourselves, alone, if it is true that we want to conquer and can conquer foreign markets, if it is true that we have acquired an international point of view and are prepared to take a leading rôle in the concert of nations, we can no longer use the present unwieldy and unscientific machinery of tariff making If we wish to make our tariff an aid to our foreign trade rather than a hindrance, there must be some continuous and thorough body empowered to collate and assemble the facts for the use of Congress Under our form of government and under our Constitution, the actual making of the tariff must be done by Congress, naturally through a committee A Congressional committee, however, is not fitted to make the careful investigations and scientific researches which should be the preliminary to any tariff making

If we are going into the world's markets, we must throw off the swaddling clothes which have protected us from the world's competition. It is only in rare cases that our industries may find it impossible to compete on equal terms with industries abroad A tariff board can but determine these questions A tariff board is another link in the chain of our preparedness for peace, and is another link which should soon be added

Let us look forward to the coming of peace, and let us prepare for the results of that peace which we can already see are inevitable Let every manufacturer and business man in the United States decide for himself what the results of this war will be, and let him make adequate preparation for peace I, for one, believe that the United States is entering on a new period in her economic history There was a time when the United States consisted of a few struggling colonies on the Atlantic coast. She gradually expanded into a great agricultural nation, and of late we have developed industrially and our manufactures have become important. Now we are entering upon a period of international commerce, when the United States will take her position at the head of the commercial nations of the world

Features of 1916 Motor Truck Design

(Concluded from page 251)

seventh of what it was two years earlier, is because most of the truck makers have considered it more advantageous to use the simpler and more efficient worm gear drive. As this form of axle is now produced in large quantities, and as the power is transmitted through but one set of gears, it can be built actually cheaper than the more complicated double reduction drive. It is not only more efficient, but it is a quieter form of drive gearing

Considering power plant design, we find that the four-cylinder motor is practically supreme in the truck field as 96.6 per cent of the 1916 trucks are equipped with this efficient and time proven power plant. The two-cylinder opposed motor is found in but 2.4 per cent of the truck models, while the six-cylinder type meets with but little favor as it is used in only 1 per cent of the trucks.

Taking up various details of engine design, the block casting predominates as 59 per cent of the trucks utilize engines having the four cylinders cast together 30 per cent of the truck engines have the cylinders cast in pairs, while but 4 per cent have the individual cylinder castings The L head type of motor in which all valves are carried at one side of the casting predominates, as 78.5 per cent of the truck engines are of this type The T head form where the valves are carried on opposite sides of the cylinder is found in 14 per cent of the truck motors. The valve-in the-head type is used on 3 per cent, while that form in which one valve is mounted in the cylinder head and one at the side is used in about 3 per cent The average engine size for the coming season is almost the same as that for the past year In 1915 the average bore was about 4¼", the average stroke 5¼", and the rating about 28-horse-power The average bore for 1916 is 4", the average stroke 5", and the average capacity, 25 horse-power

Ignition, Lubrication and Cooling Systems, and Methods of Engine Control

In considering ignition practice, the high tension magneto used in conjunction with but one set of plugs and no auxiliary battery is found on 73 per cent of the truck power plants. The dual system in which the battery is used in connection with a transformer coil as an auxiliary to the magneto is found on 27 per cent of the truck engines. Double ignition systems in which two sets of plugs are used each system being entirely independent of the other, which had a representation of about 5 per cent in 1915, are not found at all in 1916 practice

Lubrication is for the most part by the constant circulation splash method which is found on 57 per cent of the power plants The splash pressure system is used on 30 per cent, while the pressure system without splash is used on 10 per cent of the engines The average engine speed of the 1916 truck motor has been increased over that of last year to some extent since in 1915 the speed was about 1100 R P M while this year the speed is 1300 R P M The average gear ratio is such that about 15 miles per hour speed of the truck is obtained when on direct drive.

Water-cooling by pump circulation seems to be the accepted practice, although thermo-syphon cooling has made a slight increase. A point to be noticed which is clearly brought out in the graphic chart, is the almost entire elimination of the air-cooled class

The finned tube type of radiator in a cast metal case is becoming more popular than the cellular or honeycomb type enclosed in the less substantial sheet metal case. This is because the honeycomb type of cooler is a much more delicate structure than the tubular type and is also a more difficult type to repair

A feature of some importance in connection with the motor truck power plant is the method of control Hand spark advance is found on 58 per cent of the trucks this year, fixed spark on 25 per cent, and automatic advance on 15 per cent. Governors are also being applied more generally in securing an automatic control of the truck engine. In those trucks using governors the centrifugal type is the most popular

Trend of Power Transmission Practice

The next point to consider is the trend in power transmission practice The demand for cleaner chassis lines has greatly increased the percentage of unit power plants. In one of the accompanying illustrations are shown the variations in practice for 1915 and 1916.

The selective type of gear box in the three-speed pattern predominates in this year's motor trucks. The selective sliding gear form is found on 88.6 per cent of 1916 commercial vehicles. The individual clutch type is found on 7 per cent; the progressive sliding gear on 5 per cent, and the

planetary on 1 per cent. Friction drive is losing ground very fast, but 1 per cent of the 1916 trucks using this change speed gearing.

There has been a marked increase in popularity of the dry disk clutch and a decrease in the use of the cone clutch. In 1915 the various clutch types were represented as follows Dry disk, 28 per cent, cone, 42 per cent, multiple disk in oil, 18 per cent dry plate, 8 per cent, expanding shoe, 2.1 per cent, plate in oil, 1 per cent. In 1916, 48 per cent of the clutches are the dry disk pattern, 26.3 per cent are of the cone design, 13 per cent are of the multiple disk in oil type, 9 per cent are dry plate forms, and 1 per cent each expanding shoe and plate in oil constructions The gain in the dry disk clutch percentage has been made at the expense of both the cone and multiple disk in oil types.

Frame Construction and Spring Suspension

In considering some of the features of the truck chassis we find that the pressed steel frame is by far the most popular form except on very heavy trucks or those of exceptionally long wheel base where the frames are built up specially of structural iron shapes. The great increase in the application of the Hotchkiss drive principle is shown in the pronounced augmentation of the semi elliptic spring percentage The rear springs of 88.5 per cent of the 1916 trucks are of the semi elliptic form The platform spring suspension is used on 6 5 per cent The full elliptic is used on 2 7 per cent, the three quarter elliptic on 1 4 per cent, and the cantilever on but 7 per cent Semi-elliptic springs are practically universal for supporting the front of the chassis as these are found on 96 per cent of the 1916 trucks. The full elliptics are found on but 2 per cent These springs are called upon to resist driving and braking torque in 81 per cent of the trucks this year, while a torque arm is provided on 10 per cent and a torsion tube on about 7 per cent Propulsion through radius rods is noticed on 48 6 per cent of the trucks this year, which is a material reduction from the 72 7 per cent of last year Propulsion through the springs is found on 47 per cent of the trucks, which is a material increase over the 23 per cent of 1915 practice.

Tire Equipment, and Simplification of Body Design

The loads are carried in practically all trucks on solid rubber tires and there seems to be a tendency to use single tires on the rear wheels as well as on the front wheels except in those trucks where the capacity is so great that a single tire cannot be obtained of sufficient width to carry the load successfully During the past year single tires, 8-inch, 10-inch and 12 inch in width have appeared and while these have not been generally applied tests have shown that they are practical and some tire manufacturers recommend them instead of the 4-inch, 5-inch and 6-inch dual tires In 1915, 51 per cent of the truck models on the market had single rear tires. This year 55 per cent of the trucks are so equipped despite an increase in the average carrying capacity

In conclusion attention is directed to the bird's-eye view and side elevation of typical truck chassis illustrated herewith These show in a readily understandable manner the trend of average practice. The clean cut appearance and simplified design made possible by the use of the unit power plant, Hotchkiss drive and completely enclosed drive gearing are apparent at a glance. The main features of development are pointed out so that even the reader without a general knowledge of automobile construction should readily identify the various improvements. The graphic diagrams should also assist materially in comprehending the general trend of 1916 truck designing practice.

Holland in the Grip of Its Old Enemy

(Concluded from page 255)

submerged districts were used as refuges for people and cattle because the church is always on the highest spot of a village and it is often spared by the waters; in any case, it is the last bit of ground to be submerged, so that rescue can be expected there. The Queen and the Prince Consort went at once to the inundated districts and were untiringly busy visiting all the places that have suffered by the catastrophe.

Experts say that the great calamity would have been spared North Holland and the districts along the opposite side of the Zuyder Zee if the plans for reclaiming the sea had been executed The Great Dyke and embankment with the sluices closing off the Zuyder Zee to the north most certainly would have prevented the excessive piling up of the water and ensured an outlet for the overplus. In some places the flood stands three or four meters above the land, in others a few inches So alas! It is again the World War that is responsible for this disaster for owing to political uncertainty and the necessity of keeping the defensive inundation system in constant readiness, it was impossible to even begin parliamentary discussion of the Zuyder Zee plan

De Kleft Kamp, Hierden, Holland.
January 20th, 1916.

Making the Desert Bloom

(Concluded from page 243)

of stagnation in development prevailed all over the west.

In the passage of the Reclamation Law on June 17th, 1902, a new impetus was given to desert subjugation Three years later found the federal engineers engaged upon a number of the greatest irrigation works in the world, and since that time progress has been steady and substantial

To-day the whole world is cognizant of the fact that through Government effort we have constructed four of the highest dams, two of the largest irrigation tunnels, and two of the most capacious storage reservoirs on earth. A million acres of desert have been transformed into fruitful farms tilled by 29,000 families

A summation of the work of the Reclamation Service to the beginning of the present fiscal year, June 30th, 1915, shows that it has dug 9,592 miles of canals and ditches, and excavated 89 tunnels with an aggregate length of more than 25 miles Dams of masonry, earth, crib, and rock fill have been erected with a total volume of 12,200,000 cubic yards These include the four highest dams in the world The available reservoir capacity at this time is approximately 6,500,000 acre feet, or sufficient to cover the states of New Jersey and Delaware to a depth of 12 inches. The Service has built 4,622 bridges with a total length of 19 miles. Its culverts number 5,714, and are 36 miles long There are now in operation 298 miles of pipe line and 85 miles of flumes The Service has built 784 miles of wagon road much of it in what was before inaccessible mountain regions, 82 miles of railroad, 2,534 miles of telephone lines, 429 miles of power transmission lines, and 1,068 buildings, such as power houses, pumping stations, offices, residences, barns and storehouses.

The excavations of rock and earth amount to 130,149,368 cubic yards. The Government has used 2,501,882 barrels of cement, and has manufactured 1,177,215 barrels of cement and sand cement. The power development amounts to approximately 35,000 horse-power

The projects now under way or completed embrace approximately 3,000,000 acres of irrigable land, divided in about 60,000 farms from 10 to 160 acres each During the year 1915 water was available from Government ditches for 1,450,407 acres on 39,017 farms, and the Government was under contract to supply water to 1,088,008 acres. The net investment of the Service to date is approximately $100,000,000. The assessed valuation of the land and improvements is probably double this sum.

A Few of the Larger Projects

In the variety of the engineering problems, in the magnitude of the works, and in the extraordinary character and number of difficulties encountered in prosecuting the work, the Salt River Project, in Arizona, [illegible]

[illegible] of the Service. The principal and most imposing structure is the Roosevelt Dam, which blocks a narrow canyon at the confluence of Tonto Creek and Salt River. The structure of rubble masonry, arch, gravity type, is 280 feet high, 1,115 feet long on crest, and contains 342,325 cubic yards of material. All materials for the dam were found at the dam site, including the cement. The latter was manufactured in the Government's own mill above the dam, and a saving of $600,000 resulted from this unusual enterprise The flood waters of both the Salt and Tonto are stored in the enormous basin created by the dam, its capacity being 1,427,000 acre-feet, or sufficient water to cover Delaware a foot deep

The site of Roosevelt Dam is 62 miles from the nearest railway, and the region was without trails or roads. A fine highway costing $350,000 was built through the mountains before work on the dam began.

Irrigation is not from the reservoir direct. The valley lands are 70 miles below and stretch out in the form of an enormous fan. As needed, water is passed through the tunnels in the cliffs which form the abutments of the dam, and flows in the stream channel to Granite Reef, at which point a million dollar diversion dam has been built. From this canals take out on either side, extending down the river and covering about 220,000 acres of the valley In connection with the canal system several large power plants are in operation developing about 20,000 horsepower and utilized for all purposes, pumping, lighting, street cars and manufacturing The gross expenditures on this project to date are about $13,600,000 The annual gross returns from the lands in crop is more than $4,000,000 Less than 175,000 acres are in crops There are 3,600 farms irrigated from this system and the valley has become one of the show places of the southwest

Arrowrock dam in Idaho is probably the most spectacular structure the Government has built Completed last October, it ranks all other dams in the world in its height, 350 feet above bed rock It is of rubble concrete, arch gravity type and contains 585,130 cubic yards of material. It was built by Government forces in record time and at a cost of a million dollars less than original estimate. Before actual construction began the Government built a standard gage railroad 24 miles long to transport the machinery cement, and the supplies for an army of laborers employed at the camp This railway doing a regular transportation business shows a profit of $9,000 annually for five years In connection with the project three other dams were built one for diversion and power, and the others for supplemental storage The cubical contents of the last two exceeded 2,700,000 yards Boise project contains the largest area of irrigable land included in any Government project, 255,000 acres. It is a region renowned for the fertility of soil, charming climate, and excellent markets It contains 2,600 farms, and from 58,064 acres actually cropped in 1914 the gross returns were $1,033,447 The Government investment to June 1915, was $11,503,503, at which time the project was 85 per cent completed. There are exceptional opportunities here for homeseekers, as large tracts of state land remain to be sold.

Elephant Butte dam blocks a canyon in the Rio Grande, New Mexico, just below the black butte from which it takes its name This wonderful structure will be dedicated in September, and the Southwest is preparing a fitting celebration for the occasion: The dimensions of this dam are impressive. It is of rubble concrete gravity, without curve, 1,250 feet long on the crest and 300 feet high. Its volume is 610,000 cubic yards. It takes its place among the greatest structures of the age by reason of the enormous capacity of the reservoir created by it. The lake behind the dam has an area of 2,637,700 acre-feet, or enough to cover the state of Connecticut [illegible] inches deep. It is the largest irrigation reservoir ever built. [illegible] water will be diverted to [illegible] land, a large portion of which is now virgin desert.

The Minidoka Project designed to irrigate 150,000 acres, in southern Idaho, has a large power plant utilized to pump water to 5,500 acres. Surplus power is sold by the Government so cheaply that it is quite commonly used in four towns for lighting, heating, and cooking Groups of farmers have built their own power lines and now enjoy the use of electricity on their farms. Probably more farm houses on this project, which was desert in 1904, are to-day using electricity for general purposes than in any other section of the world.

Proud as we are of the great work done in the desert, let us refrain from boasting We should remember that Argentina is constructing a single irrigation system which will cost $60,000,000, that English canals water 15,000 000 acres in Egypt and 35,000,000 acres in India, and a revenue of 5 to 7 per cent is collected each year on the investment.

American people cannot rightly claim to have measured up to their opportunity until the deserts and the swamps have been replaced by vistas of prosperous farmsteads

Industrial Preparedness for Peace

(*Concluded from page 240*)

ally compete with vastly different conditions in foreign competition I say this with a full desire to see the condition of the laboring men in this country kept to a high standard, but to do this by coöperation with the employer rather than by coercion against him supported by legislators catering for votes.

"During the past ten years I have seen much destructive legislation and very little constructive I have seen much interference with business to its disadvantage and very little to its advantage I have seen highly specialized businesses covering enormous detail, requiring training of years suddenly legislatively thrust under the control of politically appointed commissioners I cannot believe that this condition can continue to exist and prosperity continue to be maintained in this country particularly after the area of foreign competition sets in and but for conditions brought about by the present war in Europe I had looked to see a very disastrous condition financially in this country during the present administration. The war has temporarily in my opinion, staved off these conditions but danger still exists and it will be accentuated, I believe, after the war

"*I believe one of the most important* and urgent of all necessities is that of a Merchant Marine not Government owned, but supported in such a way as to make competition with foreign nations possible, and with the many restrictions which now surround the American shipowner removed so that he may have the same opportunity to exist as a foreign ship owner I refer more particularly to recent legislation which but for the abnormal freight rates due to war conditions would have unquestionably wiped the American flag not only off the East and West coasts of the country but off the Great Lakes as well I do not know that anything is being done intelligently in this direction, and believe it must be sooner or later *if we are to successfully compete*"

William W Lawrence President National Lead Company, New York

"I would be very glad to favor you with my views on the various subjects mentioned in your letter and the memorandum attached, but in order to treat them properly *I think I would have to* abstain from attending to my business duties for from two weeks to a month Therefore, I trust you will excuse me from giving my views on this very comprehensive programme.

"I will, however, take occasion to call your attention to one matter which has often occurred to me in connection with what *you* call 'Industrial Preparedness.' It is this This country has had a fair example of what it means from an industrial point of view to be unprepared when they look at the case of England and France in the recent past. Both of these coun-

tries, consumers of immense quantities of munitions of war, as compared with the United States, found themselves at the beginning of the war in a state of utter unpreparedness, and it is only now, after a lapse of eighteen months, that they are commencing to reach the point, by expansion of their manufacturing facilities, where they can, with the aid of the United States, come somewhere near meeting the demands made upon them"

The Heavens in March, 1916

(Concluded from page 248)

Canis Major, Canis Minor, Gemini, Taurus and Auriga—all marked by stars of the first magnitude,—while Mars and Saturn add to the splendor, the latter in Gemini, the other higher up, in Cancer

The Planets

Mercury is a morning star all this month, but is best seen at its beginning, being at his greatest elongation (22°) on the 1st Though south of the sun, he runs more than an hour before him, and is easily visible in the dawn He is in Capricornus, moving into Pisces later in the month, and appears about as bright as Capella or Rigel

Venus is an evening star in Pisces and Uries, and is exceedingly conspicuous, being about seven times as bright as Sirius, and remaining in sight until 9 30 P M

Mars is in Cancer, past opposition, and retreating from the Earth, but still very bright, and visible until nearly 4 A.M even at the end of the month

Jupiter is an evening star and is visible just after sunset early in the month, but later becomes lost in the twilight On the 31st he is in conjunction with the sun, and becomes a morning star

Saturn is in Gemini, almost stationary among the stars and is well placed for observation, coming to the meridian at 8 P M at the beginning of the month and 6 P M at its close

Uranus is a morning star in Capricornus On the 4th he is in conjunction with Mercury, being 8 minutes of arc north of him, but it will be practically impossible to see the fainter of the planets in the strong light of the dawn

Neptune is in Cancer, about 12° east of Mars, and is well visible telescopically

The moon is new at 11 P M on the 3d, in her first quarter at 2 P M on the 11th, full at noon on the 19th, and in her last quarter at 11 A M on the 26th She is nearest us on the 20th, and farthest away on the 12th She passes near Mercury on the 1st, Uranus on the 2d, Jupiter on the 5th, Venus on the 7th, Saturn on the 13th, Neptune on the 14th, Mars on the 15th, and Uranus once more on the 29th.

At 5 47 P M (eastern standard time) on March 20th, the sun crosses the celestial equator, passing through the point called the vernal equinox, and, as the almanacs say, "Spring commences"

PRINCETON UNIVERSITY OBSERVATORY
February 22d, 1916.

A New Fire-Damp Tester

NUMEROUS attempts have been made of late years to construct apparatus which will enable miners at any time to test the air of the shaft in which they are working at any moment in order to determine its percentage of methane, so as to avoid the danger of an explosion from the deadly fire-damp Such an apparatus was devised in 1913, by Haber, according to *Naturwissenschaften* (Berlin), by means of which the methane content of mine air is ascertained by physical acoustic methods. This was given the name of the fire-damp whistle (Schlagwetterpfeife)

Now, however, investigations by Prof Beckmann and C. Steglich to determine the content of combustible substances in air have led to the invention of one or more forms of apparatus to test mine air for such matter. Prof Beckmann gives an account of this work in a recent number of the *Chemiker Zeitung* (Berlin). In this new fire-damp tester the methane content of the air is determined by chemical means, by the burning of a definite volume of mine-air and observation of the alteration of pressure thus produced within the combustion vessel. The first apparatus made was a "preliminary explosion tester," a device whose purpose is to determine whether the air contains a sufficient quantity of methane to make an explosion possible. The inventors call this a "fire-damp pistol" It is made entirely of metal and consists of a small air pump, a manometer and a "cereisenzündung," or cerium iron priming When the piston of the pump is drawn out the mine-air is sucked into its cylinder, then the stopcock of the air channel is closed and the mixture of air and methane is exploded by means of the priming When a reaction takes place it is indicated by the warming of the metal cylinder, with a higher methane content by an increase of pressure on the manometer, this is so arranged that its pointer remains at the highest point of pressure reached A cut off device (sperro-orichtung) prevents the priming of the gas mixture before the apparatus is shut off from the surrounding air, thus avoiding a spread of the explosion Combustion takes place only when the air contains from 7 to 10.3 per cent methane.

But since it is sometimes of importance in mining operations to detect a methane content in the air of 1 to 7 per cent, or of percentage higher than 10 per cent, there was a demand for the construction of suitable apparatus. In this the gas mixture is kindled by means of a platinum spiral heated to a red glow The complete combustion of methane results in the formation of carbon dioxide and water vapor, both of which are easily absorbed Hence, after such absorption, there will be a diminished pressure, which affords a means of testing the methane content of the burned gas mixture with sufficient accuracy for practical purposes

The explosion chamber of this apparatus is also made of metal and its lower part contains about 100 grammes of caustic potash, the space for gas above this has a capacity of about 140 cubic centimeters By the aid of a suction force pump (Saugdruck pump) the metal vessel is filled with the gas mixture to be burnt After continued pumping has caused the gas mixture to drive all the air out of the vessel the cock of the gas feed tube is closed and the platinum spiral attached beneath the cover of the vessel is brought to a red heat by two accumulator coils A special device is employed here also so that the current can be withheld till the explosion chamber is shut off from the outside air The combustion chamber is connected with a mercury manometer, which shows the alteration of pressure that takes place during the burning of the methane.

The warming of the gas mixture causes at first an increase of pressure, which decreases to a diminished pressure in exact ratio with the absorption by the caustic potash of the products of combustion.

The burning of the methane takes two minutes, therefore the electric current which heats the platinum spiral is automatically interrupted at the end of two minutes. At the expiration of one more minute the apparatus has cooled off sufficiently for the manometer to be read. The manometer can be so gaged that the methane content can be immediately read. It can also be connected with an alarm arranged to indicate a given percentage of methane in the air

The greater the danger of explosion the quicker the apparatus shows it. This is a special advantage of this new testing process. The degree of diminution of pressure read on the manometer was 8 millimeters for 0 5 per cent of methane, 46 millimeters for 3 per cent, and 100 millimeters for 6 per cent, the lowest boundary for explosion.

Another advantage of the apparatus is that all its parts are easily packed in a box. A simplified form, called a "Wettermess-lampe," has a rubber bulb in place of the metal suction force pump, and is also provided with an incandescent lamp.

so that it can be used as a mine lamp. The chief tester can be connected in a simple manner with a registration apparatus so as to work automatically

The apparatus can also be used to test the presence of other inflammable gases such as hydrogen and ordinary illuminating gas

NEW BOOKS, ETC.

COMMUNITY DEVELOPMENT By Frank Farrington. New York The Ronald Press Company, 1915 8vo , 257 pp Price, $1.50

It is indeed a good work which the author would further—to make the small town a better place to live in and a better place in which to do business. His suggestions will enable the local business men s organization to start right and to meet that problem which sooner or later is sure to arrive—the question of what to do next. They are assisted in finding out what their particular community most needs and how to supply those needs. It is demonstrated that in many ways the small town may have the advantage of the larger one particularly if there is intelligent coöperation in town affairs Wise advertising and an occasional celebration will do wonders The preacher the doctor the lawyer all may learn through the pages of Mr Farrington s chatty dissertation how best to avail themselves of the little town s opportunity while in turn contributing his share to the common happiness and prosperity

THE ENGLISHWOMAN'S YEAR BOOK AND DIRECTORY 1916 Edited by G E Mitton London A & C Black, Ltd 8vo 408 pp Price, 2s 6d. net.

The influence of the war is plainly apparent in this thirty fifth issue of the Year Book The section dealing with sports and games has been discontinued, and the space devoted to the more serious activities of Englishwomen as these bear upon national liberty and the same standard of honor between nations as between individuals American women who wish to keep informed upon English law social problems, and modern movements as they relate to woman, will find the Year Book edifying and instructive

HEATON'S ANNUAL. The Commercial Handbook of Canada and Boards of Trade Register 1916 Toronto Heaton's Agency 12mo , 504 pp Price $1 25

The twelfth edition of this Annual succeeds in placing before the public an astonishing amount of information on things Canadian It is a political Who s Who ' and a financial commercial and banking guide It describes leading towns and indicates local opportunities Among the many useful statistics offered are tables dealing with population illiteracy railways, the public debt fur farming and numerous other conditions and activities A noteworthy feature is the economic bibliography of government reports and standard publications relating to the Dominion under the significant caption, " Where to Find It

THOUGHTS OF BUSINESS By Waldo Pondray Warren. Chicago Forbes & Company 1916. 12mo , 260 pp Price, $1

This is the business man s Book of Proverbs That executive in embryo—the office boy and the haughty magnate who commands his humble services alike might profitably start the working day by reading one of its terse chapters These put forward the highest ideals without for a moment losing touch with the practical—a most unusual achievement in inspirational writing The pages are starred with anecdotes that light up obscure places and not infrequently radiate wholesome humor It is a book which makes one wish to meet the author and thank him in person for the genuine help he has extended

THE AUTOMOBILE BOOK By Charles E Duryea and James E Homans New York Sturgis & Walton Company 1916 12mo , 348 pp , illustrated Price, $1 62 postpaid

There are innumerable books on the automobile but this association of a skilled writer with the pioneer of the industry brings out certain points of superiority over the average treatise The work carries a most concise explanation of engine details in plain language and adds to this the fullest information on the construction, operation and care of the car The handy size of the volume is an additional recommendation and it should prove extremely popular among owners and drivers

EXPERIMENTAL WIRELESS STATIONS. Their Theory, Design, Construction and Operation. By Philip E. Edelman. Published by the Author, Minneapolis, Minn , 1916 8vo , 272 pp , illustrated

Designed especially for experimenters, this account of sharply tuned wireless installations which comply with the new law should fill a definite need The author aims at establishing a standard design for amateur stations, and addresses only those who pursue the art in a serious and business-like spirit. The principles upon which the systems are based are set forth in some detail, and the treatise, which includes wireless telephony and quenched spark systems, should be directly useful to the earnest amateur. This is a third and revised edition.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries Full hints to correspondents are printed from time to time and will be mailed on request.

(14056) A R. L. asks Have you any supplements containing articles on the preparation of phosphorescent sulphides also on the preparation of phosphorescent salts by the action of cathode rays, or in any other manner? A We have no articles in the Sup on the preparation of phosphorescent sulphides. The phosphorescent calcium sulphide is prepared from clean oyster shells and flower of sulphur The shells are calcined to drive off the moisture and destroy the animal matter Pulverise the clean portions. Put into a crucible alternate layers of the ingredients Cover the crucible and heat to redness for half an hour Cool slowly with the cover on Keep the sulphide in a stoppered bottle. Barium Sulphide may be made in a similar way from native barium carbonate Witherite, and strontium sulphide from native strontium carbonate, Strontianite. A valuable article upon Phosphorescent Bodies may be had in the Sci Am Sup No. 1684, price ten cents, which can be had from the H W Wilson Co, 39 Mamaroneck Avenue White Plains, New York

(14057) A W asks 1 Does a given amount of electricity flow faster or slower through the same size and length of wire at 0 C or at 100 C? And explain why 2 When a watch is laid on a table and one putting one's ear on the table a few feet from the watch the sound of the watch running can be heard How does the sound travel from the watch to the ear? 3 Sound waves travel faster in hot weather than in cold weather do they travel farther also? A 1 The resistance of a metal to the flow of electricity increases with a rise of temperature A metal would retard the flow of electricity as it was heated Less electricity would flow through a hot wire in a given time than through the same wire when cold With carbon the reverse is true At a high temperature carbon has less resistance than when cold Some alloys have very slight change of resistance with heating Manganin and Constantin have practically no temperature coefficient 2 Sound travels through wood much better than through the air so that you hear the watch through the table to a greater distance than through the air 3 The distance to which a sound may be heard depends upon the energy which is given to the sound With a high velocity the sound would tend to travel to a greater distance but the acoustic transparency of the air at the time is an important factor in determining the distance to which any sound may be heard The question is not a simple one.

(14058) C C C asks 1 C claims that the sun is a source of heat and light and that the closer we get to it the warmer we will be and that the farther we get from it the less heat we get H claims the reverse, that the closer we get to the sun the colder it is and vice versa Who is right? 2 C claims that the point blank range of a rifle is the exact distance it will carry up to a straight line without any drop in the missile, that a modern high power rifle with a point blank range of 1 000 yards will actually carry up to that distance without any adjustment whatever of the sights H claims that the earth's attraction takes effect on any missile fired from any gun, and that it begins a downward course from the instant it leaves the rifle, and in order to shoot 1 000 yards the sights must be adjusted to shoot that distance Who is right? A. 1 All astronomers believe that the sun is the source of light and heat and that it becomes hotter at a less distance from the sun and colder at a greater distance from the sun Some poet has written of the remote planets, 'One moment's cold like theirs would chill our bones, Freeze our heart's blood and turns us all to stones 2 The Century Dictionary defines 'A Point blank Range' as the distance a missile will carry before striking the level from which it is fired, the axis of the gun being horizontal The modern high powered rifle with its rotating pointed projectile will carry a long distance at point-blank range.

(14059) L. G L. asks The writer desires to learn the different principles involved in electric water heating Particularly those devices wherein an electrically charged body or current is immersed in or passed through the water, either from a storage battery or street current. A. When an electric current is passed through a coil submerged in water all the current is converted into heat and applied directly to the work of heating the water There is the least loss in this of any mode of electric heating. The coil is usually encased in a German silver tube, and has a flexible double conductor to connect it to the circuit. The coil does not constitute a charged body. A current of electricity flows through it just as it does through any similar wire. There is a heating coil or resistant wire for the current, and the heat is produced by the resistance of the conductor, and the amperes of the current, according to the law that the heat is proportional to the resistance, the square of the current and the time.

(14060) M. M. O'C. asks: Will you please tell me through your "Query" column how cold must it be to be twice as cold as 32 degrees above zero. A. There is no definite scientific meaning to the phrase "twice as cold." Warmer means more heat, and colder means less heat. Twice as cold may, however, be taken to mean half as hot. The degrees of the thermometer as ordinarily used only imply relative intensity of heat. They do not express quantity of heat, as does the expression "twice as cold." There is a scale, called the Absolute Scale, in which the degrees are related as quantities. Its zero is called the absolute zero temperature. A body cooled to this zero will have no heat remaining in it. This zero is 459 degrees Fahrenheit, below the ordinary Fahrenheit zero. A body at 1 degree absolute will have a certain quantity of heat in it, at 2 absolute it will have have twice as much heat in it 32 degrees Fahrenheit is 491 degrees absolute, and half of this is 245.5 degrees. This may perhaps be called half as hot as 32 degrees Fahrenheit. The Fahrenheit zero was fixed arbitrarily at the temperature of melting salt and ice. It has no natural nor scientific meaning. We had this question many times ten years or more ago At that time the Chief of the Weather Bureau gave this answer to an inquirer, "The expression 'twice as cold' has no definite meaning, and is not used in scientific language, nor in rational popular English We simply say 'warmer' for more heat and 'colder' for less heat. He then showed as we have done how the absolute scale might be applied to the case and proceeded as follows 'It is not possible to say anything more definite than this, as the expression 'twice as cold' can have no real significance until a scale for measuring cold has been adopted Heat is measured upward from the absolute zero of temperature, but cold must be measured downward from some arbitrary point that has never yet been defined."

(14061) J S H asks As the result of a discussion it has been decided to refer the matter to you for arbitration The query being the composition of carbons, such as are used in motion picture lamps

1 What is the base of the article, carbon as found in coke or in its purer state of graphite? 2 Does clay of any sort enter into the composition? If so, what is its purpose? 3 How are carbons formed (in molds or through a die)? 4 How is the hardness of carbons controlled? 5 What temperature is used in heating? A Arc light carbons are made of graphite pulverized and mixed with some binding substance, such as tar or even cheap molasses, and then forced into molds with great pressure The soft rods are now baked in a furnace without access of air till all the material is reduced to carbon Clay would not be used in carbons since it would reduce the power of burning the carbons Clay is silicate of aluminum largely and this is very difficult of reducing to its elements. The compression in the molds makes the rods compact and hard The red heat of a coal furnace is used, probably 2000° Fahr or perhaps higher Descriptions in full of the making of carbons may be found in Sup Nos. 1558 and 1827, which may be had from the H W Wilson Co. White Plains, N Y at ten cents each

(14062) K H asks 1. Will you answer a question or two for one of your constant readers? What is the *shape* of a light wave? We are told in the text books that light waves are transverse ripples in the ether Very well We are also told that waves move outward from the light source in spherical shells. All this is very confusing, indeed If we hold a bell out in the field and strike it longitudinal waves move outward as spherical shells, and that is very easy to understand, but how transverse ripples can move outward from the light source as spherical shells is by no means easy to understand, and what becomes of the statement that light moves in straight lines? 2. Are there any books in print dealing with magnetism in the light of the electron theory? What are they? I am a book buyer, and I know that you sell books. I am a private buyer, however but I have many scientific works. 3 Are the ether waves that give us the wireless telegraph circular or spherical waves? I am told that the wave length may be several miles. Is that true? That would seem to mean that the wave itself has the form of an oscillating sphere, and that the first wave has advanced that distance before the second wave starts. Can that be true? I have attended lectures by advanced monists, and they make one's head feel like a bee hive. Recently one of these lecturers explained that the person who claimed that the electron has an independent material nucleus must produce some positive proof, as all the proof we have of the electron is its electric charge, some kind of disturbance in the ether. Can all these things be? A. 1. You may be helped to imagine the motion of a light wave by considering a wave motion in water. The water moves up and down, the wave moves over the water. If you drop a pebble into a basin of water [illegible]

the pebble strikes the water you may draw as many straight lines as you please out to the sides of the basin. Along these lines the wave front will travel The entire wave front will be a circle but any element or minute portion of the wave front is moving outward, a straight line In this way a water wave proceeds outward from a point in straight lines, but the wave front is circular whenever the disturbance is produced at a point Now suppose a small ball is up in the air, white hot. Light will proceed from it in waves just like those of water The vibrations are crosswise of the motion of the wave The wave is a transverse wave Lines may be drawn outwards from the ball in every direction These lines will comprise a sphere if they are equal in length Any small portion of the wave front will travel outward from the ball along one of these straight lines The entire wave front is a spherical shell Any element of the wave motion is traveling along the straight line drawn outwards from the ball from the point at which this element of the light started We trust this may be clear to you Any small portion of the light which goes from a lamp to my eye goes in a straight line but all the light from the candle goes out in spherical shells over all the space in which the candle is visible 2 The new edition of Thompson's Elementary Lessons in Electricity and Magnetism just issued which we send for $1 50 gives the new theories of magnetism and electrons 3 The waves of wireless telegraphy are considered to be transverse waves like light waves but of much greater wave length If a wave has a length of a mile the second wave will start when the front of the first is a mile away Since the speed is nearly or quite that of light this presents no difficulty A wave ten miles long will pass out in 1/18000 of a second 4 We hold no brief for the monists and must refer you to them to explain their views Doubtless they will be willing to discuss them with you

(14063) F H asks 1 Can I make an apparatus for measuring the relative intensity of daylight at different times (not the candle power)? If not will you explain how it is done? 2 A friend and I want to communicate by telegraph Will you kindly explain the apparatus used for telegraphing on a fine uninsulated copper wire with induction currents? Could a railway be used because of the relatively great resistance of iron to high frequency currents but as these travel upon the surface of a conductor could not zinc covered fence wire be used for short distances? 3 Since the yellow flame of an oil lamp and the carbon filament lamp give the softest light for reading I would like to know which would be most *efficient* 1 the carbon filament lamp or, 2 a highly incandescent filament lamp with a ray filter or a colored reflector? 4 In the process of making silage is the heat sufficient to kill all the life or vitamines of the raw material? A 1 You can measure the relative intensity of daylight with any form of photometer as compared with the light of a candle The relative intensity is usually expressed in candles You will however find the light very different at different distances from the sun and you should record the number of degrees from the sun approximately at least You can obtain a photometer from dealers in physical apparatus You may find a portable form especially adapted for work out of doors 2 You can use the rails of a track or the wires of a fence for a telegraph line A zinc coating on the wire will have no effect upon the transmission by the wire We have no diagram of connections to send you 3 The tungsten filament lamp is more efficient than the carbon filament incandescent lamp Its strong light may be toned down by the use of semi opaque shades to diffuse the light These can be had from dealers A mode of lighting called the semi indirect system is very pleasant. 4 Dairymen now seek to have the silage kept as sweet as possible so that little acid and no disagreeable odor may be produced This is brought about by cutting the corn fine, packing it while rather dry and filling the silo slowly so that it will be packed down as closely as possible The silage then heats spontaneously to a temperature above 122 deg Fahr which kills all ferments and prevents further chemical action

(14064) R B C asks Would you kindly inform me what theory or theories are held to account for star twinkle? A The twinkling of the stars is produced by the unsteadiness of the air It is greatest in cold weather and when a high wind is blowing It is also due to the fact that a star is a shining point and has no sensible disc For this you should consult Todd's New Astronomy which we send for $1 45 postpaid. You will find many interesting explanations of astronomical matters in this book

(14065) F E F asks What becomes of the current in the primary of a transformer? It seems to me that since it is changed into a current of another voltage in the secondary it ought to disappear in the primary else where does the induced current come from in the secondary? Does not the induced current in the secondary itself induce back a current in the primary thereby strengthening the inducing current? Moreover would not inductions pass back and forth between the coils an indefinite number of times like the reflections in a pair of parallel mirrors? But then would not the result be zero at least so far

as the current in the secondary is concerned since both currents have to contend with self-induction? In the above I am supposing the lines of force to increase in number. But when they decrease what prevents the currents in both primary and secondary from building each other up indefinitely by induction and self induction, the direction of the self-induced current being now identical with that of the inducing current, and not reacting against it? Do you call the current induced in the secondary of a transformer a true alternating current, seeing that there are two pulses in one direction followed by two pulses in the opposite direction? A The current which does the work in a transformer and induces the secondary current, is constantly supplied by the generator at the station It requires a continual replenishing of power to the dynamo to produce more current, so that the same amount of current is continually flowing through the line and the apparatus along the line The induced current in the secondary acts upon the primary but in both directions, so that the result is zero It does not replenish the primary current. More power and not less, is required in the primary, or as we say there is a percentage of loss in the transformer The current in the secondary keeps step with that in the primary, and is an alternating current.

(14066) J O L. asks Can an ounce of water be destroyed or diminished? Can any matter be reduced in its component quantity so as to apply the word "destroy"? A It is a fundamental principle of modern science that matter can neither be created nor destroyed. Not a drop of water can be destroyed that is its weight be made to disappear from the universe, by any process within the power of man Water can be changed into oxygen and hydrogen gases, but the gases will weigh just as much as the water from which they were derived.

(14067) L M S asks May I trouble *you to answer the following questions and* thereby settle an argument? Can a six volt storage battery be changed fully by a current of less than six volts? We have a 10-volt shunt wound generator of thirty amperes Can we change ten 80-ampere hour batteries with it they being connected in multiple? Kindly *recommend a book on the repair of storage batteries* Are both plates i e neg and pos of a storage battery pasted with red lead? A A lead storage battery is charged at the rate of 2½ volts per cell, and discharged to 1 8 volts per cell A six volt lead battery would have three cells, and at 2½ volts per cell requires *a charging current of 7½ volts. If it is* quite discharged a current of 6 volts will bring it part way up but cannot complete the charging of the battery It cannot charge the battery fully Four cells can be charged in series with a 10-volt current, since 4 x 2½ are 10 With your 10 cells you can make 2½ series of 4 cells each and connect the series in multiple To complete the half series a wire resistance equal to that of the two cells should be put in series with the two cells You will then have 3 series of 4 cells each in value, and your dynamo can give 10 amperes to each series This should be sufficient to charge them unless they are very large cells If you are in doubt about this refer the matter to the firm who made the battery They can tell you what the proper charging current is Lyndon's Storage Battery Engineering is the authority on the subject of storage batteries We send the book for $4 One plate is ordinarily pasted with red lead and the other with yellow lead.

(14068) J H asks Will you please tell me the estimated rapidity, at which electrons travel? A If the modern theory of electricity is true the electron has a great number of velocities Thompson, in the new edition *of his Elementary Lessons in Electricity* and Magnetism which we send for $1 65, says on Page 2 Electricity is now regarded as consisting of immense numbers of excessively minute atomic quantities equal among themselves each atomic quantity being called *one Electron.'* A current under this hypothesis is a procession of electrons, and its velocity is the velocity of the electrons. This velocity through metals will vary and be still different from the velocity through electrolytes and gases The limiting velocity is that of light which is but a streaming of electrons. The boldest conjecture in this theory is that electricity comes from the sun shot across space to the earth Yet there is no reason why this should not be so if light is an electrical phenomenon as Maxwell demonstrated it to be and as all physicists have taken it to be since his time.

(14069) G W G asks: I would like to obtain the names of at least three liquids that expand the most upon raise of temperature and the amount of their expansion. Is the expansion constant, that is, suppose a certain liquid to be in a room whose temperature was 70 degrees, and the temperature of the room was raised 5 degrees, would the liquid expand the same amount as it would in the event that it was in a room where the temperature was 40 degrees and the temperature then raised to 45 degrees? What is the law governing the expansion of liquids? Take for example the case of a small necked bottle completely filled with liquid. The temperature of the liquid is raised 15 degrees. Will that portion of the liquid that is in the neck of the bottle move a greater distance than the portion of the liquid which is in the body of the bottle? Are all liquids compressible? If

etc., what is the compressibility of water? What effect has temperature upon the compressibility of a liquid? A The four liquids which have the largest expansion by heat, as given in the Smithsonian Physical Tables page 286 are ether pentane, acetone and carbon disulphide The coefficients are as follows

	Range of Temperature.	Coefficient of Cubical Expansion
Ether	—15—38	0 00151824
Pentane	0—33	0 0014646
Acetone	0—54	0 0013240
Carbon disulphide	—34—60	0 0011398

The expansion of liquids is not constant but varies with the temperature being larger for higher temperatures The expansion of each liquid must be determined for itself There is no law by which the expansion of an unknown liquid can be calculated If a liquid is in a bottle uncorked and is heated the liquid will rise into the neck and the expansion will be shown there The expansion is apparent however since the expansion of the bottle makes the bottle larger and the liquid does not rise so high into the neck of the bottle by the amount of the expansion of the bottle The real expansion of the liquid is the sum of the expansions of the liquid and the bottle This is the case with a thermometer All liquids are slightly compressible The compressibility of water is given for many pressures and at different temperatures in the tables named above on page 79 A new edition of these tables is in course of preparation If you desire us to notify you when the volume is ready kindly advise At 20 C and 0—100 atmospheres the mean compressibility of water is 0 0000468 The compressibility in general increases as the temperature rises

(14070) A H asks Will you kindly advise me what book is published that gives the best information regarding the relationship of the pigment colors? So far as you know has anyone ever solved the mathematical relationship? If not would not such a work be of immense value both educationally and commercially? A There are many books upon colors and their relations We can furnish them upon your order You will find a selection of four in our Catalogue of books of which we are mailing you a copy It does not seem that a book giving the proportions of color mathematically would have a wide sale since all artists mix their colors by the eye or as a great artist when asked what he mixed his colors with said With Brains You will find in Vanderpool's Color Problems, price $5 many examples of color mixing with 117 colored plates

(14071) F M J asks Will a bullet dropped reach the level sooner than one fired from a gun? The barrel of gun to be perfectly level The range of bullet to be perfectly level bullet dropped to start from same height and at exactly same time as the one fired from barrel leaves muzzle of gun both bullets alike and all atmospheric conditions the same A A bullet dropped and a bullet shot from a gun which is adjusted perfectly level at the same instant are both of them falling bodies from the instant they are released and they fall equally so that they remain at the same level all the time They will strike a level plain below at the same instant The velocity given by the powder does not affect the velocity downwards given by gravity Gravity works on the bullet independently of the powder and produces its effect just as if the powder had not acted upon the bullet at all

(14072) C W D asks Does the sun rise at different hours on different days in the year in Porto Rico and set at different hours in the Philippines? Are the hours of darkness between Porto Rico and the Philippines the same in June as in December A The latitude of a place makes considerable difference in the times of sunrise and sunset during a year especially in places far from the equator For places in the Torrid Zone the times of sunrise and sunset vary very little from six o clock throughout the year Porto Rico and northern Luzon are in the same latitude and in the Torrid Zone There is very little difference between these places in the hour of sunrise and sunset

(14073) N B H asks 1 Has anyone ever accounted for capillary phenomenon and surface tension of liquids on the basis of gravity or Newton's first law? Or has any such hypothesis been advanced? If so it is never mentioned in the text books. 2 When a stove or stove pipe gets red hot or white hot does one really see through the iron to see the smoke going up the pipe or is that just an appearance caused by waves of heated air on the outside playing on the heated metal? It certainly looks like the smoke waves rolling off the fire, but I did not believe that iron was ever transparent 3 If an engine should "kick loose" a train of box cars on a level track with a certain velocity, and if a certain number of brakes were on, suppose a brakeman on top should release these brakes—would the cars then go faster than their rate when these brakes were set? That is, would the energy that was being used by the brakes be converted into an increased velocity, or would it merely make the cars go further before coming to rest? A 1 We have never seen any effort made to account for capillarity or surface tension as an application of inertia. Newton's first law of motion is the expression of the fact of inertia. 2. You can easily find

if an iron stove-pipe is transparent when red hot by hanging a black iron ball in the pipe and seeing if it is visible through the iron while still below a red heat. Arrange the ball so that it can be lowered to the red hot part from some place higher up where the pipe is not red hot. We expect that you will find the flickering which you have observed is in the air on the *outside* of the pipe. This can be seen over a hot stove or radiator which is far below the red heat 3 Cars running wild on a level track would not have any increase of velocity upon throwing off the brakes, since no new force would be given to the cars. They would move on with the velocity which they had at the moment the retarding force was removed and would run till friction on the track brought them to rest They would run further, but not faster Since the retardation due to the brakes would cease it would probably seem as if the cars increased in speed, but this would be due to the fact that the slowing down due to the brakes was stopped

(14074) L. L. B asks A cube, 4 inches on the side, weighing W pounds and perfectly inelastic rests on a horizontal surface with one side in contact with a perfectly inelastic, immovable vertical wall A pressure of *1 pound per square inch* is applied to the side opposite that in contact with the wall The coefficient of friction between the horizontal surface and the cube is f Is the reaction between the cube and the wall equal to 16 pounds or 16 Wf pounds or has it some other value? A In the case which you propose to us, it is our opinion that the pressure of 1 *pound per square inch is transmitted* through the cube to the wall in the same manner as if the cube were connected without a joint to the rod which exerts the pressure If a beam 4 inches square were pressing against the wall, with 1 pound per square inch the pressure would be 16 pounds The cube 4 inches square is in contact with the wall and does not move during the experiment. Its friction does not enter into the case till it moves The cube seems to us simply to serve to transmit a pressure not motion

(14075) L. B M asks 1 I understand that the force of attraction of the moon on the earth causes the tides to rise and fall about 58 inches, while the sun causes a rise and fall of about 25 inches. Under these conditions please explain why the tides rise and fall only 2½ feet at the Atlantic side of the Isthmus of Panama and about 10 feet at Rockland Maine In fact as far as I know the tides rise and fall more and more as we come up the Coast Why do the tides rise so high in the Bay of Fundy? Why do the tides rise and fall on the Pacific Coast end of the Panama Canal 21 feet and on the Atlantic end only 2½ feet? 2 Gases liquids and solids, according to the kinetic theory, contract when cooled Please explain why water when cooling from 4 deg Cent to make ice does not conform to the above theory as most substances do and bismuth, cast iron and water expand upon solidifying A If you will get a Physical Geography at your public library and study the map of the tides you will see how greatly the coast line and the depth of the oceans affect the tides If the earth were a sphere covered with water the tide would have its theoretical value but near a shore and in shallow water the tide is greatly changed, as you know by the height of the tide along your coast and especially in the Bay of Fundy The tide at the Atlantic end of the Panama Canal is very small because of the long distance which it flows from the open ocean and the shallow and narrow openings through which it makes its way It has come a long distance from the Cape of Good Hope, and the moon is long past the meridian of Panama This last is also true of the Pacific end of the canal but the flow on the Pacific side is through deep water in the Pacific Ocean and the funnel shaped bay makes the tide deeper as it does in the Bay of Fundy The subject is very complicated and we have but given hints for starting one in the study of the subject You will be interested in the Tide Predicting Machine of the U S Coast Survey which takes into account the numerous causes of inequality in the tides at any place, and gives both the time and height of the tide for any day at any date It is described in the SCIENTIFIC AMERICAN Vol 110 No 10, price ten cents 2 We are not able to give a reason for the peculiar expansion of bismuth cast iron and water when changing from the liquid to the solid form.

(14076) G H McG asks What is the exact nature of the law applying to the secrecy of wireless messages? A The simple form of expression used in all of the wireless laws makes them easy of understanding to any one Therefore, in answering this question the law may be quoted. "No person or persons engaged in or having knowledge of the operation of any station or stations, shall divulge or publish the contents of any messages transmitted or received by such station, except to the person or persons to whom the same may be directed or their authorized agent or to another station employed to forward such message to its destination, unless legally required so to do by the court of competent jurisdiction or other competent authority Any person guilty of divulging or publishing any message, except as herein provided, shall, on conviction thereof, be punished by a fine of not more than two hundred and fifty dollars or imprisonment for a period of not exceeding three months, or both fine and imprisonment, in the discretion of the court."

Let Your Battery Shift the Gears

To Automobile Manufacturers

THE adoption of the electric self starter several years ago at once opened up a tremendous new field for the sale of automobiles as there were then numberless men and women who would not purchase because of the necessity of cranking the motor by hand

The self-starter removed this objection, and it cannot be doubted that this was an important factor in bringing about the greatly increased sales which soon ensued

There still remain thousands of potential buyers, chiefly women, who would purchase automobiles today if it were not for their inherent inability to master the present awkward system of shifting gears by hand. Many men would feel that they could afford to buy a car if it could be driven during the week by their wives and daughters

Your dealers doubtless have many people on their list of prospects with whom they could close at once if the gear shifting difficulty were out of the way, but who will not buy a car of any kind until they can obtain one equipped with a simple means of shifting gears The C H Magnetic Gear Shift provides this and its adoption will open up an entirely new field for automobile sales which means greatly increased business for the motor car trade in general

Makes gear shifting as easy as switching on an electric light

THE power, speed, mileage and economy of gasoline *plus* the convenience of push-button control

Push-buttons mounted under the rim of the steering wheel, out of the way of lap robe and overcoat, put the control of the car literally under your thumb

If you want this combination insist that your next car—the car you are going to buy this Spring be equipped with the

C-H MAGNETIC Gear-Shift

The battery that lights your car and supplies the power to crank your motor can also be made to relieve you of the burden of gear shifting The power is available—why not make it work for you in this way?

The electric current necessary to operate the Magnetic Gear Shift is negligible The amount consumed in one hour by your lights is sufficient to shift gears four hundred times Considerable less current is required for a single operation of the Magnetic Gear Shift than for a blast on the electric horn

You will probably be told by certain automobile manufacturers and dealers that the Magnetic Gear Shift is an experiment and is therefore unreliable They said the same thing of the electric self starter at first and opposed its adoption until the force of public demand compelled them to supply it

Make inquiries concerning The Cutler Hammer Mfg Co look us up in Dun's or Bradstreet's inquire of your banker—ask any one in the electrical trade what our standing is and then ask yourself whether it is likely that we would stake our reputation and place our guarantee on the Magnetic Gear Shift if it were not exactly what we represent it to be Realize that if it were not an ***absolutely dependable device,*** as it has been proven to be by extended and exhaustive tests under every conceivable condition we could not afford to take the chance of backing it with our unqualified guarantee

Remember, that the company back of the C H Magnetic Gear Shift is numbered among the world's largest manufacturers of electric and magnetic appliances More than $25 000,000 worth of Cutler Hammer apparatus is in daily use on land and sea Magnetic gear shifting is ***not*** an experiment, it is an accomplished fact—it is here—you can get it on some cars ***now.***

The Cutler-Hammer Mfg Co.

Electrical Controlling Apparatus For All Purposes

Main Offices: MILWAUKEE **Factories: MILWAUKEE and NEW YORK**

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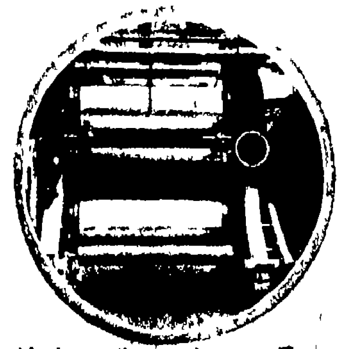

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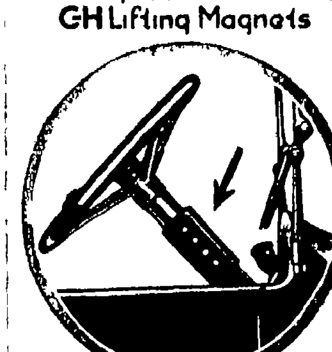
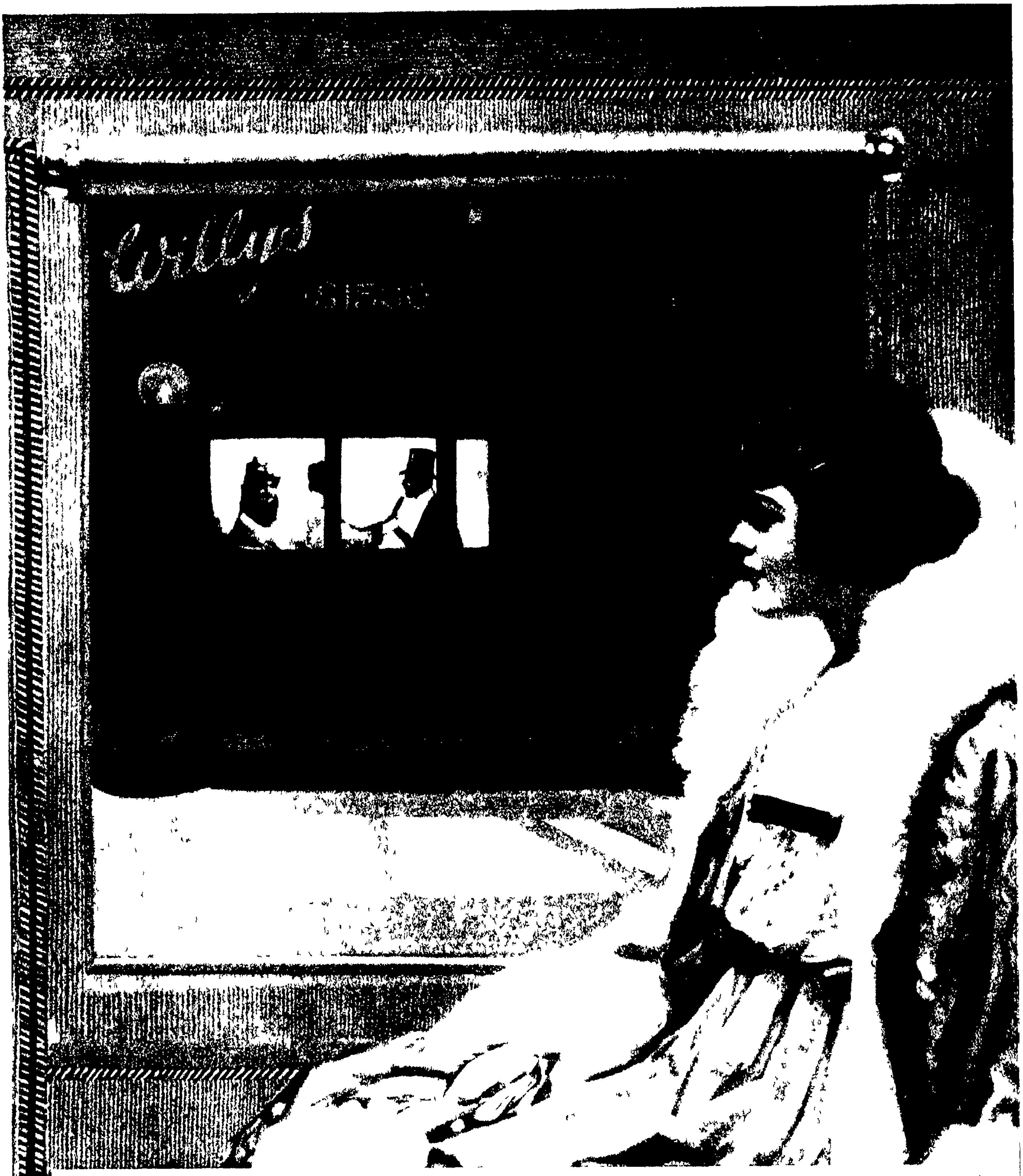
All Large Steel Plants use C-H Lifting Magnets



Over A Million C-H Automobile Lighting Switches in use

All Push Button Electric Light Sockets are a C-H Product



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The Willys-Overland Company, Toledo, Ohio

Made in U. S. A.

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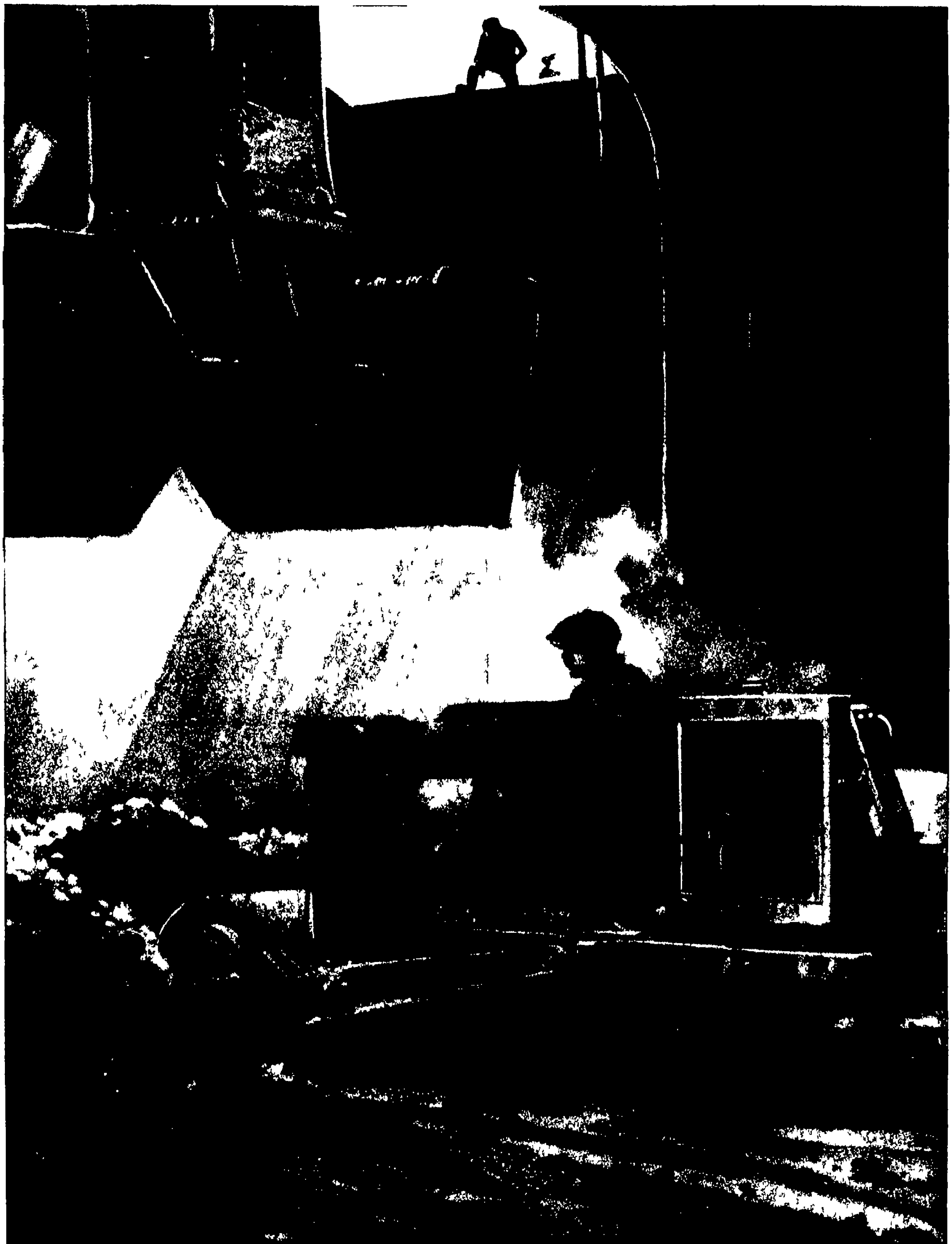

GASOLINE SHOVEL AND UNLOADER CO-OPERATING IN REMOVING THE CARGO OF AN ORE SHIP.—[See Page 279.]

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Motor truck artillery train of Battery A, Los Angeles National Guard, nearing San Diego during the recent run to that city from Los Angeles

America's First Motor Truck Battery

By Joseph Brinker

PROVING the great superiority of motors over mules for the hauling of coast defense artillery, the motor truck train of Battery A, Los Angeles National Guard, recently made a 184 mile run along the Pacific Coast from Los Angeles to San Diego and maintained an average speed of 20 miles per hour, thus making in an hour's time by motor truck what would ordinarily be an entire day's trip for mules. It is said that the train America's first organized volunteer motor reserve corps hauled the battery a farther distance and at a greater speed than ever before accomplished over an American road.

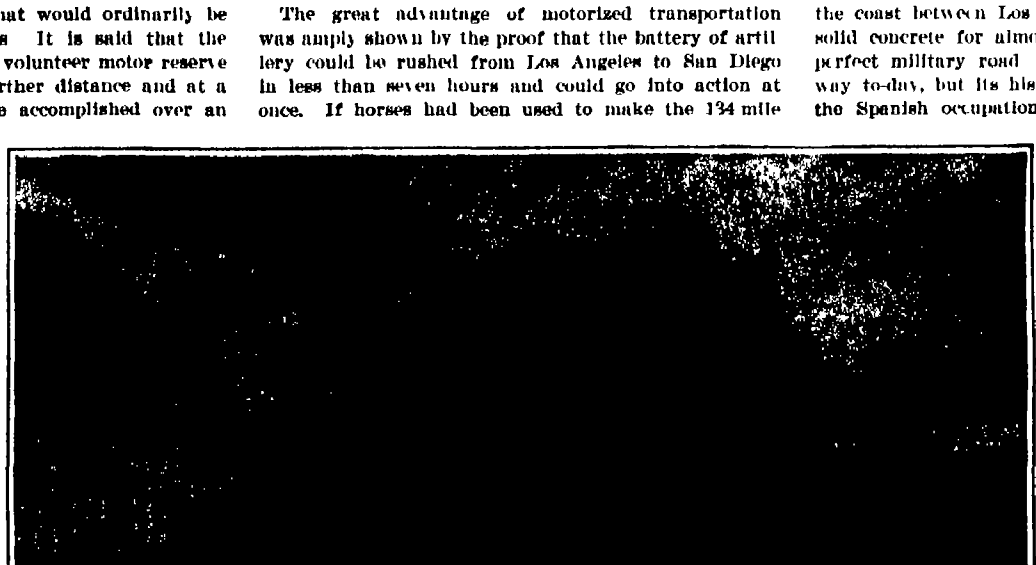
The motor truck train was made up of an officers' car and five trucks—a one-ton truck which acted as a scout car and four four-ton trucks, the latter each hauling a three-inch field gun and caisson. Three of the trucks carried the 0 men making up the battery crew, while the fourth carried extra caissons, spare gun parts and the ammunition.

The demonstration was in the nature of a test which should go a long way toward revolutionizing coast defense, according to Capt. McComas of the battery, who said:

"We moved the entire battery to San Diego and return without a mishap and this is a feat because of the speed maintained. The guns are mounted on carriages built for shorter and slower horse travel. For long-sustained speeds the carriages should be mounted on rubber-tired wheels similar to those used on motor trucks, but the ones employed nevertheless stood up remarkably well despite the steady running."

The guns were not mounted on the truck chassis ready for fire, as are many of the famous French 75s now used in Europe because the trucks were only loaned to the battery for the purpose of proving what trucks could do in rushing guns to points along the coast under conditions which prevail in time of actual war were a foreign power to attempt to land a force.

The great advantage of motorized transportation was amply shown by the proof that the battery of artillery could be rushed from Los Angeles to San Diego in less than seven hours and could go into action at once. If horses had been used to make the 184 mile run it would have taken at least two days, and then under such extraordinary severe conditions that both horses and men would have been worn out before going into action, instead of fresh and ready for work as was the case with the truck equipment. If the battery had been shipped by rail it would have taken at least four hours to load the guns and horses at one end and unload them at the other, or half as long as it took for the motor train to make a dash and get into action.



American motor truck artillery train at the San Juan Capistrano Mission on the run between Los Angeles and San Diego

Much of the success of the demonstration, insofar as the speed maintained is concerned, was due to the excellent road over which the run was made. It skirts the coast between Los Angeles and San Diego and is solid concrete for almost the entire distance, being a perfect military road. It is called the King's Highway to-day, but its history dates back to the time of the Spanish occupation of lower California when it was called El Camino Real. In those days it joined all the picturesque adobe missions built by the gentle yet militant Padres of the Church and was used for trading between the various missions. It was traversed by the Spanish royalty on its visits of inspection from whence it got its name King's Highway. Without this perfect road the average speed of 20 miles per hour maintained by the artillery train would never have been possible. It is a shining example of the value of military roads along both our coasts and the facilities they would extend to American legions in case of war.

Another startling result of the demonstration is the fact that the cost of operation of the truck train was only ¼ cent per ton mile for the 208 miles of the run to San Diego and back. The official figures showing the tabulated cost of the operating expenses of the trip were compiled by Lieut. Sterling Booth, Cal. N. G.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Preparedness That Prepares

WE have recently been warned by President Wilson that the country is in a condition of grave danger, and that it is impossible to foretell what a day may bring forth. To many of us—to all of us, in fact, who have appreciated the sinister significance of the "Lusitania" outrage and the devious diplomacy which it has begotten—the growing menace to the United States has been only too clearly and too long apparent. Out of this conviction of peril has grown the insistent and widespread demand that emergency measures to protect the country by greatly increasing our naval and military forces be at once put in force.

Now this movement for preparedness, as everyone is well aware, had its beginnings and lusty growth among the private citizens of the United States. Congress and the Executive either ignored the movement or strongly condemned it, at least in its earliest stages. Of late the Administration would seem to have taken alarm, and this change of attitude has found its strongest and most dramatic expression in the public warnings of the President himself.

The trouble with much of the Administration's belated insistence upon the need for preparedness is that the remedial measures are too much in the future, that they fail to meet the present emergency. There are some defensive measures which can be taken at once and require no legislative action to put them in force, for it is not necessary to delay action until a complete reorganization of the military establishment or the plans for enlargement of the navy has been fully worked out. The war in Europe has now been running its course for over a year and a half, and although during that time, as we are now informed, the menace to this country has grown to a point of grave danger, the present Administration has failed to do the things immediately next to hand and make those enlargements of the military establishments for which it had full authority under the existing statutes.

To particularize, *it is only necessary to consider that the United States army is to-day nearly fourteen thousand men below its statutory strength*, that is to say, throughout the period of this war the Executive has had the power to bring the army up to its full strength, as authorized by law, of one hundred thousand men. On the contrary during all this time of peril infantry regiments have been maintained within the continental limits of the United States at less than half strength, cavalry and field artillery regiments at about 25 per cent below full strength, and the coast artillery organizations have been alarmingly short in numbers—all of which deficiencies could have been met in part at least, by bringing the army up to its full statutory strength.

Furthermore, during these times of imminent peril our arsenals have been partially idle. Congress has been importuned over and over again for the special appropriations necessary to put our arsenals at work for the purpose of making good our shocking deficiency in artillery and ammunition providing an efficient fire control system in our coast defenses, and commencing immediately on a large scale, the construction of new carriages to take the place of the present obsolete type of carriage that now so seriously limits the efficiency of our sea coast guns. Indeed it might be possible, by a slight mechanical change in the existing carriages to permit them to give the guns that full elevation which is necessary to make them effective for distant ranges—a change which would vastly increase the efficiency of our batteries at a relatively insignificant cost.

A grave and insistent danger threatening the United States? Undoubtedly. A pressing need for preparedness on a large scale? Without doubt. But why, in the name of consistency and common sense, if the danger is so great and the need so pressing, do we fail to make those immediate preparations which can be put in force to-day, some of them without the necessity for legislation and the rest by the voting of moderate appropriations?

Battle Cruisers for the Line of Battle

SEVERAL years ago, when the first battle-cruisers of the "Invincible" type were set afloat, the SCIENTIFIC AMERICAN was greatly impressed with the obvious strategical and tactical value of this new type of warship and we earnestly recommended the addition of a division of these ships to our main fleet. It did not take the eye of the naval expert to realize that the combination of a battery of armor piercing guns with engine power capable of moving that battery across the high seas at a speed of five or six knots greater than that of the major units of the enemy fleet, presented a fighting unit of such range and power that the possession of one or two divisions of such vessels would exert a powerful determinative influence upon the next war, if, indeed, it did not prove to be decisive.

The publication of our articles led to a protest from the Navy Department, and we were informed by the chief naval constructor of that time that it was the opinion of the General Board of the Navy that, although the battle-cruiser possessed undoubted merits, it was nevertheless something of a spectacular and expensive luxury, and the appropriation for a division of battle-cruisers would be expended to much greater advantage if it were put into slower and more heavily armed battleships.

In those days there was a strong prejudice in our navy against the battle-cruiser on the ground that its armor was too light to enable the ship to lie in line in a general engagement, where it would stand but small chance of remaining afloat under the attack of the enemy's high explosive armor piercing shells.

"Other times—other customs." The brilliant work done by the British battle-cruiser during the present war has fully verified the faith of its designers, and our General Board has so far reversed its earlier opinion that it is now recommending the construction of one or more battle-cruiser divisions. Admiral Knight, indeed, the president of the Naval War College at Newport, in his recent testimony before the Senate Naval Committee went so far as to recommend that we defer the building of any more battleships until we have added to our fleet eight ships, or two divisions, of the battle-cruiser type.

Having in mind the early objection of the Naval Board to battle cruisers on the ground that they could not enter a general line-of-battle engagement, an objection which is equally valid to-day, we suggest that our Bureau of Construction should get out a design for a battle-cruiser carrying sufficiently heavy armor, say of a minimum of twelve inches, to enable it to stand up in the give and take of a battleship engagement. It has been stated in some of Mr. Daniels's press notices that a design is being got out for a battle-cruiser of thirty-five knots. Such a speed would call for at least 140,000 horsepower. Having in view the all around usefulness of such a ship, would it not be advisable, if this enormous speed has really been contemplated, to cut down the engine power to the equivalent of thirty or thirty-one knots, and utilize the weight thus rendered available by raising the armor to a minimum thickness of twelve inches? In such a ship we should have an ideal type—a line-of-battle battle-cruiser, a ship which could perform its primary functions of screening its own fleet and finding the enemy and bringing him to action and could then take its place in the battle line of the decisive engagement.

The advisability of providing our battle-cruisers with armor of battleship thickness is even more urgent to-day than it was when the new type made its appearance. In the past few years there has been a notable advance in long range gunnery. The British, in the North Sea fight, landed on the fleeing Germans at 17,000 yards. In his testimony before the House Naval Committee, Admiral Fletcher stated that seven out of forty two shells fired by one ship at target practice had struck a 20 by 60 foot target at 16,000 to 18,000 yards, and that the "Wyoming" had put three 12-inch shells through a 10-inch plate at 12,000 yards.

Criticism and Creation in Science

THE critical faculty in man is not only often distinguished from the creative faculty, but is even set over in opposition to it. A critic is often presented to us as a man who cannot create, and Nietzsche has asserted that no great creative artist can be a critic, and yet, on the other hand, one comes across such phrases as "creative criticism." Such writers as have expressed their opinions on this subject have usually confined their attention to creation and criticism in the Arts, and the conclusions they have reached seem to be somewhat confused. But if, neglecting literature, music and painting, we examine science from this point of view, we obtain an unequivocal answer to our question; is the creative faculty entirely distinct from the critical faculty? The answer is—to adopt a form beloved by the British Parliament—most decidedly in the negative.

If we examine the scientific work of recent times we shall find that it has been almost entirely critical, and yet, although it has destroyed some of the cardinal dogmas of the old orthodox science, it has not left us a mere jumble of ruins, but has opened to us vistas wider and deeper than any we have seen before. It is as if the old pillars of science were not so much supporting a structure as obscuring a view. Let us take, as one example, the old dogma of the invariability of mass. Whatever we did to a body, the mass of that body was supposed to remain constant. If we heated it, then usually its volume became greater—but its mass remained unaltered. If it were a chemically compound substance, we could resolve it into its constituent elements, but the combined masses of these elements would equal the original mass of the substance. Experiments of great delicacy were made to test this generalization, and it emerged triumphant from all the tests. The statement that the mass of a body remains unaltered was one of the pillars of science. Criticism has sapped at this pillar, and at the present day that pillar has fallen, an irretrievable ruin, to the ground. We now regard mass as a varying quantity. The mass a body has when it is at rest is different from the mass it possesses when it is in motion, and for every variation in its motion there is a corresponding variation in its mass. Nay, even when it is moving with a uniform velocity in a straight line, it possesses, at one and the same time, two distinct masses, a transverse and a longitudinal mass. Modern scientific criticism has destroyed one of our old beliefs, but in doing so has greatly extended our scientific horizon.

We will refer to another fundamental doctrine of the old science, which has been destroyed. Nothing in the old science seemed more unshakable and more fundamental than Newton's three Laws of Motion. The last and, in some respects, the most important of these stated that action and reaction are equal and opposite. The whole of dynamics, including astronomical dynamics, phenomena ranging from a weight hanging at the end of a string to the great body of theory built up around the action of the moon on our tides, and of our tides on the moon, seemed to support this law. Yet now we deny it. We assert that action and reaction are not always equal and opposite. A body on which a ray of light impinges experiences a pressure, as was foreseen by Maxwell and Bartholdi and verified experimentally by Lebedeff. The experiments by which this result is obtained are very delicate, but there can be no doubt about the result, more especially as there is a presumption in its favor from the well known phenomena attending the passage of a comet close to the sun, phenomena which had led Faye to throw out a suggestion of this kind. Now, the pressure calculated by Maxwell cannot be reconciled with the Newtonian principle of action and reaction, since the instant when light impinges on a body is not the same instant when light was emitted from the source. This is not all. A profound mathematical analysis by Poincaré has shown that the violation of Newton's third law of motion is a necessary consequence of any electromagnetic theory which takes account of certain optical phenomena—the partial "entrainement" of light waves.

The two cases we have given could easily be multiplied. In each case, when we came to study the genesis of the modern theories, we should find the processes of criticism and creation inextricably entangled. It is perfectly evident that certain constructive theories presuppose a criticism and denial of statements which up till then had been taken for granted. This critical and at the same time creative tendency in science is perhaps nowhere made more manifest than in the study of the non-Euclidean geometries. Even to the instructed mind there seemed something so obvious and necessary about the assumptions of Euclid that even to question those assumptions was in itself a considerable critical achievement. As we know, Bolyai and Lobachewsky questioned those assumptions and simultaneously created a new geometry. The influence of their work has been profound. It has radically altered the way in which we regard a mathematical axiom or postulate in the region of geometry. It was a supreme critical achievement, and was at the same time a supreme creative achievement. In scientific work, at any rate, the two kinds of mental activity cannot be clearly separated. We cannot point to a preliminary critical operation where assumptions are examined and the ground cleared, and then to a creative operation where a new structure is erected on the ground so cleared. The two processes go on together, and so far as science goes, it is perfectly true to say that we create by criticising, and that we criticise by creating.

Electricity

Multi-Telegraphing by Photography—It is reported that a Norwegian, Frederik Dahl, has lately patented in several countries a system which permits of the simultaneous transmission of any number of words by means of an automatic photographic-electric apparatus. Experts who have examined the invention are of the opinion that it will revolutionize the existing methods of telegraphy

Transmission Line Cables and Sleet—After extended experience with sleet conditions, engineers of some of the most important Canadian power transmission lines have arrived at the joint conclusion that for ordinary sizes of conductors used the worst conditions may be taken as ⅜ inch of sleet adhering to the wire at 32 deg. Fahr and a wind pressure of 11 pounds per square foot of effective area It is held that a factor of two is required under these conditions

An Ultra-Modern Knight of the Road—It is reported that a "hobo" is traveling along the Northern Electric Railway line in northern California, carrying with him a folding frame of iron interlaced with copper, which he connects with the third rail so as to cook his meals by electricity Furthermore it is reported that he also carries a long wire which can be hooked over a trolley line to supply current to the same appliance The story is interesting and humorous, technically, it is somewhat dubious

A Combination Electrolier and Phonograph is the latest offering of an American phonograph manufacturer The electrolier or electric table lamp is somewhat larger than the conventional type and its base serves to hold the disk record turntable, electric motor, talking box and other essentials The sounds produced by the talking box are led up through the pedestal of the lamp and released beneath the glass shade, which throws them downward and outward, augmenting the volume at the same time There is no trace of the phonograph mechanism from without when the door in the base is closed and the uninitiated are completely baffled as to the source of the music when seeing the phonograph lamp for the first time

Steel Tires Heated by Electricity—A prominent American automobile manufacturer is using electricity to heat the steel tires of the wheels which must be brought to a red heat before being placed on the wooden members. For this purpose the steel tires are laid in a steel tub surrounding a transformer coil which acts as the primary while the tires become the secondary of a transformer It is said that motor truck tires, which are about 0.5 inch thick, 10 inches wide and 36 inches in diameter, are brought to red heat in about three minutes' time Not only is the danger from fire greatly reduced by electrically heating the tires, but the method also lays claim to more uniform and rapid heating as well as the elimination of soot or oxidation.

Tungsten Arc Lamp of British Make—The British *Electrician* in a recent issue describes the first commercial tungsten arc lamp placed on the market in England It is known as the 'Pointolite" lamp and is especially intended for use in projection apparatus The light produced by the lamp emanates from a small ball of tungsten, which is placed directly over the ionizing filament. When the arc is struck the ionizing filament is immediately moved away from the tungsten ball by an automatic bimetallic support, slightly lengthening the arc and avoiding aging of the portion of filament opposite the ball when cold The lamp in its present form can only be used on direct current. It is supplied with a resistance box, permitting of its use on circuits of voltages ranging from 100 to 250

Lead Cables Perforated by Beetle—A discovery of much importance to telephone and electrical engineers in the United States was recently announced by Albert Schuler, general manager of the Santa Barbara (Calif) Home Telephone Company After five years of persistent effort to determine the cause of minute holes in the lead armor of aerial telephone cables, Mr Schuler established beyond question that the holes are bored by a comparatively small beetle with powerful mandibles. For years the telephone company was troubled by short circuits in the aerial cables due to minute holes in the armor, resulting from some unknown cause. Electrical experts who were consulted ridiculed the suggestion that the holes were caused by insects and laid the trouble to electrolysis Several men who were detailed to travel along the line and watch out for suspicious bugs were soon rewarded for their trouble. They captured a number of bugs in the act of drilling into the lead armor of the cables Specimens of the bug were sent to Dr Van Dyke, Entomologist at the University of California, who classified them as *Sinoxylon declive*, a kind of beetle that ordinarily attacks wood, particularly live oak logs or cord wood.

Science

Search for Oil in Australia—There is a promise of important developments as a result of long continued efforts to find petroleum in South Australia One of the local oil companies has driven down a pipe to a depth of 1,400 feet near Robe, and oil is now showing strongly, with little gas Petroleum, as distinct from shale oil, has not previously been found in Australia

The Manufacture of Viruses, Serums and Toxins—According to a recent report of the Public Health Service there are now 41 establishments in this country and abroad licensed to manufacture viruses, serums, toxins and analogous products for the treatment of human beings and over 60 different products are propagated therein The establishments producing viruses, etc., for use on domestic animals are much more numerous

The Electrical Dissipation of Fog—The Smithsonian Institution announces in its last annual report that it has made an appropriation to further experiments in the dissipation of fog by electricity, and that the investigations will be carried out under the general direction of Dr F G Cottrell, who has already done much toward the practical precipitation of dust, smoke, and chemical fumes in large industrial establishments. As every reader of the SCIENTIFIC AMERICAN knows, the idea of dispersing fog by electrical methods has been before the public for a number of years, though it appears never to have reached the stage of feasibility on a commercial scale The subject has recently aroused fresh attention, particularly in the neighborhood of San Francisco through researches planned by the University of California in coöperation with the United States Lighthouse Service The American Institute of Electrical Engineers has also appointed a committee to coöperate in this work According to the Smithsonian report the essential element to success seems to be some form of electrical apparatus of very high direct voltage, with facilities for its control and ready application

"Smoke" from Mount Hood—From time to time press dispatches have reported that smoke has been seen issuing from the crater of Mount Hood the loftiest volcanic summit of Oregon The latest report of this kind came from The Dalles last October The whole subject of this alleged smoke is discussed in the *Monthly Weather Review* by Mr F D Young, of the U S Weather Bureau It appears that there are three kinds of "smoke" that rise from the top of Mount Hood, and all three depend upon meteorological conditions and the peculiar topography of the mountain summit The first is merely snow, which, when the wind is strong and in the right direction, is blown from the cliffs inside the crater rim and thrown high into the air The second type of 'smoke" consists of clouds which drift into the open side of the crater rim and are transformed into an almost perpendicular column of vapor by the rising air currents where the cliffs converge A third possible form depends upon the fact that there are large patches of rock within the crater hot enough to vaporize any water that may fall upon them A hot surface of this kind lies almost directly under the cliffs forming the crater rim and Mr Young thinks that if a snowslide should occur that would throw a large quantity of snow on that spot the steam generated could be seen for some distance

Macquarie Island Meteorological Station.—The meteorological station on Macquarie Island, in latitude 54° 50' S, longitude 159 E, established by the Australian Antarctic Expedition in 1912 has since been maintained at the joint expense of the Australian and New Zealand governments It has a wireless station which is in touch with Hobart, Tasmania, and Wellington, New Zealand. It sends out daily weather reports which are of special value, because the island is a sort of a halfway house to the Antarctic continent, the conditions on which largely influence the weather in Australasia However, the Prime Minister of Australia stated recently that it was very probable the station would be abandoned because of the heavy cost of getting supplies and equipment to this lonely spot, and also because of the difficulty of finding officers willing to undertake a duty which involves such a Robinson Crusoe-like existence The island is 900 miles from Hobart and is situated in the west winds belt of the Southern Ocean, one of the stormiest regions in the world A few months ago the Australian federal trawler "Endeavor," which was sent down with a relieving officer and supplies, was lost with all hands, twenty one in number The only visitors to the island are men who extract oil from the sea elephants and penguins, which abound there These spend several months there each summer, but for the rest of the year it is absolutely deserted. The island was formerly inhabited by a peculiar wingless parrot, which is believed to have been exterminated by cats accidentally introduced

Industrial Efficiency

Importance of Proper Ventilation—Roughly speaking an increase in production of 10 per cent is not at all unusual in the average office shop or warehouse, following the installation of a ventilation system Fresh air properly circulated is an essential factor in successful factory management

Cost of Labor in Manufacturing Electrical Goods—According to the latest available reports of the Pennsylvania Bureau of Industrial Statistics the labor cost on more than $30 000 000 worth of electrical supplies manufactured in the state in 1912 aggregates 38 per cent of the total value Aside from the mining and preparation of coal this is the largest labor cost in percentage of all industries in the State of Pennsylvania

Imports of Chemicals, Drugs and Dyes into the United States showed an aggregate value of $5 709 141 during November and of $75 851 879 during the eleven months ending with November 1915 thus making the year's indicated total approximately $80 000 000 compared with $87 675 573 in 1914 and $101 292 097 in 1913 With the exception of argols and gums the imports in chemicals drugs and dyes have fallen off to a considerable extent and the prices risen during the past year

Oil-Engine Ships to be Constructed Here—It is announced that two large shipbuilding firms in the East have signed contracts with a leading shipbuilding firm of Amsterdam, Holland, whereby they will construct under license in the United States a line of four-cycle Diesel type engines. For a number of years these American firms have been watching the development and progress of the Diesel-driven motor ships in both mercantile and naval service

Temporary Factories for Munitions Trade—Portable buildings of small size have become quite common during recent years, but a portable manufacturing plant is a comparatively recent development of this form of construction. The circumstances met in the munitions trade has caused at least one American organization to erect large factories These structures are bolted together, although in appearance they are of the most substantial design It is planned to disassemble and remove them to the main plant some time in the future

Contemplated Co-operation Between Universities and Big Business—The Chamber of Commerce in the United States is at present inquiring into the possibility of bringing about closer coöperation between the universities and large business interests. It has been suggested by W M McCormick of Baltimore, that the Chamber of Commerce call a meeting in Washington of the presidents of twelve prominent universities and the heads of twelve industrial firms. The object of the meeting would be to discuss how the universities can so organize their courses of study as to make their students of immediate value to the industries upon graduation

Inexpensive Operation of Oil-Engine Freighters—The economies obtained in the operation of a motorship as compared to a steamer are almost unbelievable due to the fact that there are no large boilers or stokeholds in the former and because the consumption of oil fuel is only one-fifth that of a coal or oil fired steamer, so the bunker and boiler spaces thus saved can be given over to extra cargo With a tramp steamer of 10 000 tons about 600 tons of extra cargo can be carried and at the present high rate of freights the economical advantage in a year is enormous apart from the large saving on the fuel bill

Routing of Periodicals Through Organizations—In a recent issue of *Factory* there is suggested a simple yet most effective method of routing periodicals through a business organization A form known as a "circulation slip is pasted on the front cover of the periodical to be routed In the first column are placed the names of the department heads to whom the copy is to be passed the next column is for a check mark followed by two columns headed, respectively See articles on pages and See ads on pages and finally a column for remarks The person having charge of the routing fills out the circulation slip after reading through the periodical following which it is passed on through the organization

Electric Delivery Wagons Cheaper than Horses—Records kept by a New York firm for six months disclose the fact that on the basis of cost per vehicle per day, without reference to the amount of work performed horse wagons are the cheapest. On the other hand, continues *The Edison Monthly* since an electric can do more work in any one day cost of delivery per package shows the electric 5.3 per cent cheaper than horses, in bulk delivery the economy increases to 12.6 per cent One great saving found characteristic of the electric vehicle is in the elimination of time spent between stables and the store Electric vehicles in this instance are housed in the store basement and in one adjoining something manifestly impossible with anything but electrics

The War Game.—I

A Strategic Reconnaissance of Four Cavalry Patrols

By Lieut Guido von Horvath, formerly of the Austro-Hungarian Army

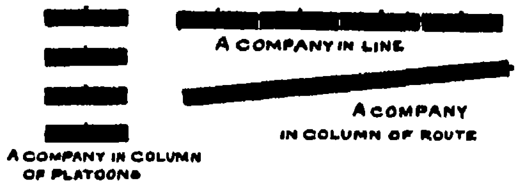
TO learn the art of war, no other method is so commendable as to apply the rules of warfare to the war game. Its importance in the European armies is fully recognized and during the winter season such games are conducted by every garrison

There was a time when the conducting of a war game and the carrying out of its details and developments was a very tedious work The reasons for this were that an almost endless series of tables with chances of loss by infantry and artillery fire percentages of disabled, wounded and sick soldiers, tables for the influence of weather conditions the passage of hinderances, etc, were used

All this, however was abolished quite a while ago and the chief guides in conducting these games became commonsense and simple arithmetic To these as a matter of course was necessary the tactical and strategical knowledge demanded by the task itself and the influence of the modern machines of war upon the enemy from the infantry rifle up to the guns of whatever caliber used not forgetting the saber, the bayonet and the spade

THIS is the first of a series of War Games which will be conducted in the SCIENTIFIC AMERICAN *by Lieut Guido von Horvath, formerly of the Austro Hungarian army As explained in our issue of February 26th Lieut von Horvath by his training at the Military Geographical Institute at Vienna is eminently fitted to conduct such a series*

Solutions of the problems contained in this war game will be answered in the next installment of the series —EDITOR.



A company in column and in line

In military circles the war game just as an actual maneuver will take its natural course In our case, when we want to enlighten the participants first in the details of tactics and strategy to be applied in that particular phase of the game our proceeding will be slower and will dwell on smaller engagements and will gradually lead up to greater tasks with the growing understanding of the theories of war

The fundamental principles of war are neither numerous nor in themselves very abstruse but their application is rather difficult, for, above all they cannot be made subject to set rules The correct application of principles is regularly the outcome of deep military knowledge, developed into instinct However military science is not different from any other science and talent in these lines, and above all genius will march to the front at a lively rate

The action of an army or any part of the same is Fight, strategy and tactics High sounding words as they are, they can be traced back to the same old story, where Jim and Tom, two boys, had their first scrap over an apple core

Jim had the apple and promised Tom the core (the first diplomatic intercourse) Tom watched the apple disappear and when it looked as though the proceedings would endanger that core then he started a diplomatic parley to secure what he believed was rightfully his. Jim urged on by greed, declared "There ain't goin' to be no core" which of course was almost equivalent to an ultimatum Diplomacy then and there ended and Tom had recourse to strategy He picked up a broomstick and threatened Jim from the side which looked most promising for securing his aim

Jim at this action quite naturally began to work along strategic lines himself He made perfectly sure of the core then grabbed another stick for defense or if a quick attack appeared more promising he jumped at Tom with doubled fists From here on, the mutual belaboring of each other with fists is the simplest application of ancient tactics.

This example makes it clear that both these sciences are to a degree inborn and this fact gives confidence in the success of the war games conducted by the SCIENTIFIC AMERICAN, for its readers

To participate in these games one has to read the theories which precede each task then after a short study of the terrain illustrated by a large-scale general staff map to proceed with the solution of the given questions The correct solution of these tasks with explanatory notes will appear in a later number

Topographical map of the region where the reconnaissance is to take place

NORTH

Military map of the region pictured above with explanation of signs employed

The Characteristics of the Arms Which Compose an Army

The fighting troops of an army are composed of infantry cavalry artillery, engineers, cyclists and flying corps. The proportion of these units is, under ordinary circumstances, to give a rough example 60 per cent infantry, 20 per cent cavalry 10 per cent artillery, 6 per cent engineers, 3 per cent cyclists, 1 per cent flying corps.

The infantry and cavalry might undertake certain tasks singly, the artillery and other units are dependent upon the assistance of the other arms. For success the perfect coöperation of the units is most important The cavalry, being outfitted with long-range rifles, can undertake infantry actions.

For actual field maneuvers, it is necessary to acquire terms, commands and all the details by which a troop is brought into the demanded position and location For the participant of these war games, it is sufficient to know the formations and the lengths of these formations.

In the following will be given the information which is absolutely essential to the disposition of any action. Generally speaking from a layman's standpoint, there are three important formations for all arms. These are

The gathering,
The marching,
The fighting.

For example, we shall take a company The company is formed of four platoons, each numbering, let us say, 40 men. It gathers in *column*, marches in *columns of fours or twos*, and fights *in line* (See accompanying sketch.) By taking four matches, it is very easy to understand the general principles of the leading of a company for war games. These principles apply as well to cavalry and, to a great degree to artillery, also

According to the questions involved, the necessary explanations will be given at the very points of application, thus avoiding unnecessary repetition of explanations. In regard to distances, we shall do well by figuring the length of a company in line or in marching order as 100 yards long The depth of a column of platoons is 16 yards. Now, to dwell for a moment more on this question, since the battalion is formed of four companies the distance will be four times as long, with a trifling additional distance for space

The regiment is formed of four battalions, the brigade of two regiments, the division of two brigades To each division a regiment of cavalry is added The artillery has, in place of company, the term battery, and one battery consists of six to eight guns. A division might have four to eight batteries at its command. A company of engineers, a squad of cyclists and two fliers and an additional train will constitute the full complement of the division

All this understood, we can return for a minute or so to the example of Jim and Tom to get the necessary momentum for our first attempt at a war game.

Strategy and Tactics

At that moment when the diplomatic intercourse between the two boys has ceased, their minds were set on ways and means by which each could acquire the aim in mind.

To use an authority, according to Clausewitz, strategy is the science which teaches the art of applying battle to win the aim of war, and tactics is the knowledge of directing the action of the arms. Therefore, we could state that strategy is the planning of the war and tactics is the fighting it out. Whereas strategy might not be influenced by certain battles, victorious or otherwise, tactics concerns itself with even the smallest skirmishes among advanced posts.

This will make it clear that between Jim and Tom, very little strategy was wasted, and their main actions belong, more or less, to tactics.

Let us suppose that the scene between the boys took place in the back yard. Jim was sitting on the fence and Tom was leaning against the shed wall, a few

(Continued on page 283)

A Remarkable Belt for Conveying Sugar in Bulk

THE gigantic conveyor belt shown in the accompanying illustration is of peculiar interest for the reason that a similar belt has carried 2,000,000,000 pounds of sugar.

Confronting a sugar refining company some ten years ago was the problem of catching and carrying 125 pounds in a lump from a fall of 4 feet, at the rate of 8,200 per day. The solution of the problem was arrived at in the form of a 36-inch, seven-ply belt, which was installed at that time. Since its installation it is estimated that the belt has carried over 2,000,000,000 pounds of sugar before exhibiting any signs of wear. True the belt is an enormous one and represents a large investment, but the service it has rendered is said to have exceeded all expectations.

Recently, the same sugar refinery installed the new gigantic belt which appears in the accompanying illustration. The man shown standing beside the belt is 5 feet 11½ inches tall. The belt is 1,448 feet long, 36 inches wide and weighs 11,983 pounds.

It is claimed that, estimating eight hours run without any delays, a bag of sugar will drop into the belt every nine seconds, and if the speed of the belt is such that it can make 26 to 27 revolutions every eight hours, the bags will rest at intervals of 12 feet apart. At this given speed, therefore, the belt will carry a continuous load of 60 bags or 7 500 pounds and every nine seconds its heavily burdened surface will receive the sudden jolt and strain caused by 125 pounds dropping 4 feet. Such service is unusual in its severity and certainly ample proof of the astonishing strength of the belt.

A gigantic conveying belt that is destined to carry over two billions pounds of sugar

An English coal cutter of the rotating cutter bar type, electrically operated

Electrically Operated Coal Cutter of English Design

THERE recently has been brought out in England an electric coal cutter for which many interesting claims are made, in fact, the machine is said to represent the very latest progress in equipment of this nature.

The new machine, which is known as the Pick Quick, is of the rotating cutter bar type. It is designed to occupy as little space in height as possible, so that the machine can be made to work upon coal seams of slight thickness—as low as 16 inches, for instance, and it is adapted to all the different conditions which are to be met with in this class of work, thus permitting of its operation in cases of exceptional difficulty where other types of coal cutter fail to work satisfactorily.

Either alternating or direct current motors are mounted on the new coal cutter depending on the nature of the current supply available in the mines. The motors are of an unusually rugged construction and provided with casings to effectively keep out dust and moisture. The motor drive is laid out so as to work in an easy manner, and there is an absence of shock when the tool grips as sometimes happens with other types of coal cutter. Such is especially the case with the alternating current motors, and the three-phase motors of the coal cutters start up with a small current and allow of being a squirrel-cage armature, this being of course of a much more substantial build, and it is claimed that the collector ring armature, which was required for other machines using a long cutter bar, can now be dispensed with. Owing to the fact that there is no gripping of the cutter bar in the present case, the motor does not need to be designed for a heavy overload, which is obviously an advantage.

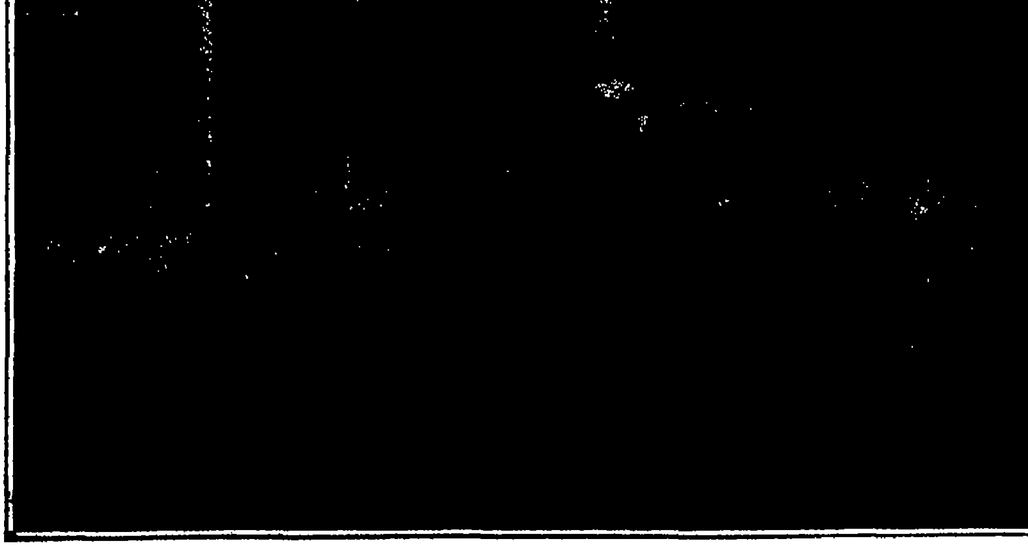
The Pick Quick coal cutters are made in three different sizes according to the kind of work which is to be done and the power of the motors ranges from 12 to 26 horse-power. The motors operate on 450 volts for both the direct and alternating current types, and require from 22 to 50 amperes. The net weight of the machine with the medium sized cutter bar is from 1 4 to 2 8 tons. It may be added here that the adjustment of the machine and cutter bar can be carried out so as to adapt it for working in different positions.

A Gasoline Shovel which Helps Unload Ore Ships

IN order to expedite the work of unloading ore ships with an ore handler there has been employed a considerable number of men in the past, whose duty it was to shovel ore from the remotest corners of the hold towards the jaws of the ore unloader. Obviously, this feature of the unloading activities has added considerably to the expenses of handling ore.

Now comes a substitute for the human ore handlers in the shape of a gasoline shovel. As may be seen in the accompanying illustration this machine consists of a substantial three-wheeled truck driven by a powerful gasoline engine. The operator sits in front of the engine where he can obtain an unobstructed view of the shovel member mounted in front. The shovel may be raised or lowered by means of cables that wind on a drum.

The gasoline shovel is so designed and constructed as to admit of ready maneuvering about the hold of an ore ship. The operator can shovel ore from the remotest corners to a position within convenient reach of the ore unloader which dips through an open hatchway. Not only does the gasoline shovel replace a number of men in this form of work, but it also accomplishes the task in a shorter time than the usual allotment of laborers to each ore vessel.



View in the hold of an ore ship, showing a gasoline shovel in operation for the purpose of bringing the cargo from the remotest corners to within reach of the ore unloader

Special Course of Instruction on Storage Batteries for Naval Men

LAST Fall an electric storage battery manufacturing concern of Philadelphia initiated a scheme of instruction for the officers and men operating the submarines of the United States Navy. As a result, during the months of November and December each of these men spent one week in hearing lectures on storage battery design and operating delivered by the engineers of the battery company and were also given instruction in shop methods. Over 100 officers and men took this course. About five weeks' time was devoted by the concern to this work, and the men and officers expressed great appreciation of the help thus received.

The course of instruction was originally laid out by the storage battery concern and approved by Admiral Grant, chief of the submarine "Flotilla," and his aide Captain Yates Sterling, Jr. It was then sanctioned by the Hon. Josephus Daniels, Secretary of the Navy.

Since the storage battery is a vital feature of every modern submarine and usually the least understood of all the equipment of such craft, the course of instruction that has been given the naval officers and men in this subject is highly commendable.

Rapid Development of the Tilefish Industry

IN its investigation of the possibilities of the tilefish industry, the United States Bureau of Fisheries finds that there is some reason to believe that the fishing grounds extend some distance toward Cape Hatteras although up to the present time they have been developed only as far south as about the latitude of Atlantic City. In the extension of the field the zone in which both the depth and temperature are suitable is probably much narrower than farther north.

The commercial fishery for tilefish continues to develop. During the month of January 308,000 pounds were landed at New York in 17 trips by six fishing vessels, or an average of 23 400 pounds per trip. This is an increase of 135 per cent over the amounts landed during December. The price remains uniform at an average of about six cents per pound to the fishermen.

Strategic Moves of the War, March 3rd, 1916

By Our Military Expert

THE ominous quiet of the past few months on the intrenched fronts was broken at last as expected. With another attempt to maintain the initiative, Germany has hurled at least eleven army corps, half a million men, against the defenses of Verdun, the key to the entire French position south of Rheims.

It is entirely conceivable that the price in blood that must be exacted from the launching of this venture would be justified by success. The direct road to Paris from Metz, the shortest line of general approach from Germany proper, lies through Verdun. It covers the line of the Meuse, it controls most important lateral railway communications, it is the keystone of the great defensive arch outlined by the positions of Rheims, Verdun, Toul and Epinal, even Belfort on the south most flank. But it is almost inconceivable that with the present development of the defensive in warfare, Verdun should fall. France has learned not to place its faith in mere defensive walls—an error that materially shortened the Franco-Prussian war. The cupolas, parapets, emplacements and turrets of steel and concrete which stud the various forts about Verdun, are by no means the principal reliance. They house guns, and only great accurate shells may destroy them, as at Liege, Namur and Maubeuge. Yet they must be destroyed ere triumphant infantry, the backbone of an army, can sweep over them in assault successfully. But the trenches and approaches through which reinforcing troops may stealthily be brought to a threatened point safe from the curtain of fire inevitably poured in from hostile guns to prevent reinforcing of the line, are the arteries of the system. Line after line of trench, with shelters and bomb proofs, are strewn broadcast in successive lines. The first may fall and if the enemy continue to pour in troops, the second, the third, the fourth, until a gap appear in the line of forts, but the toll will have been so heavy that only prohibitive resources in flesh can win through.

When its present position in the line is considered, it is evident that Verdun, defensively, is more of a detriment than an asset to France. As the *Woevre* salient, peaked at *St. Mihiel*, juts into the French line, so does the *Hautes de Meuse* sector, its rounded nose encircling Verdun, project saliently into the German line. It forms an initial point for the undertaking of attack upon Metz should the Entente decide to assume the offensive, it is a danger, a threat. But to man this Verdun salient the French line must be extended to almost double the length it would be were the line straight across from the *Argonne* to *St. Mihiel*, requiring double the number of men to occupy it.

Germany's object in this attack is then probably two-fold, first, to make the effort to break through and pour unending legions upon Paris, and so materially affect the general situation that terms of peace may be more readily considered by the Entente, or even bring the war to an end. Secondly, in default of success in entirely breaking the line, but by gaining possession of Verdun and the salient, the position might be materially strengthened at a saving in much-needed men to hold it and compel the retirement of the French lateral positions to a less threatened line. In that event, the menace against Metz would be removed.

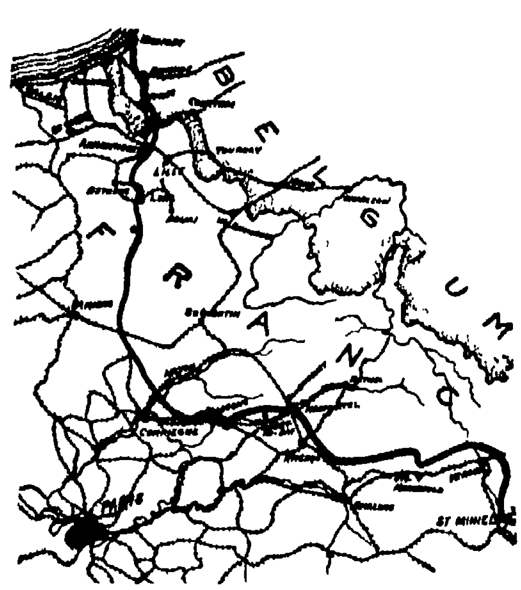
The Kaiser has launched his attacks directly upon the Verdun salient, with sufficient demonstration of activity to north and south to hold opposing troops in place so that reinforcements may not be stripped away and hurried to the endangered sector.

The objective appears to be the northern flank of the salient. The recognized manner of attack of such a position is to batter in the sides and, if possible, so threaten its defenders by a *cul-de-sac* as to compel their speedy retirement.

Twenty forts and thirty-some smaller defensive works form the *enceinte* of the Verdun defenses. Farthest advanced of the forts in the direction of Metz except for lesser works somewhat to the southeast, Ft. de Douaumont fell before the combined sustained rain of shell great and small poured in by the German batteries and the mad assaults of infantry regiments, after the outer lines of intrenchments held with comparatively light force had been driven back. The original line ran from Consenvoye on the Meuse almost eastward, then angled to the southeast beyond Ornes. It was thrust back on the right in the vicinity of the river until it lay through Consenvoye, Brabant to Samogneux, thence eastward to Beaumont and Ornes and beyond. The defending line to the westward of the Meuse was then compelled defensively to retire to Bellincourt, Forges, Regneville and Champneuville at the river again, as the troops to the eastward were forced back toward the southern extremity of La Cote de Pouvre, south of Louvemont, south of Fort de Douaumont almost to the lines of Forts de Sauville and de Vaux.

A blinding snow storm developed after the attack was launched which, while it may have aided the attack by the concealment it afforded, also made rapid advance impossible. Along the southern and eastern sides of the French salient attacks were also made, but the result achieved at the moment these lines are written seems to indicate merely a demonstration in force.

The outer shell of the first defensive line has scarcely been cracked. Without doubt effort will be made to reduce the various forts with heavy artillery, and thus widen the gap, but there still remains to the east of Verdun a number of forts and many, many trenches. Back of these the Meuse flows, a forbidding natural obstacle. And the bulk of the Verdun forts lie west of the Meuse behind the river and the assault.



Relation of Verdun to Paris

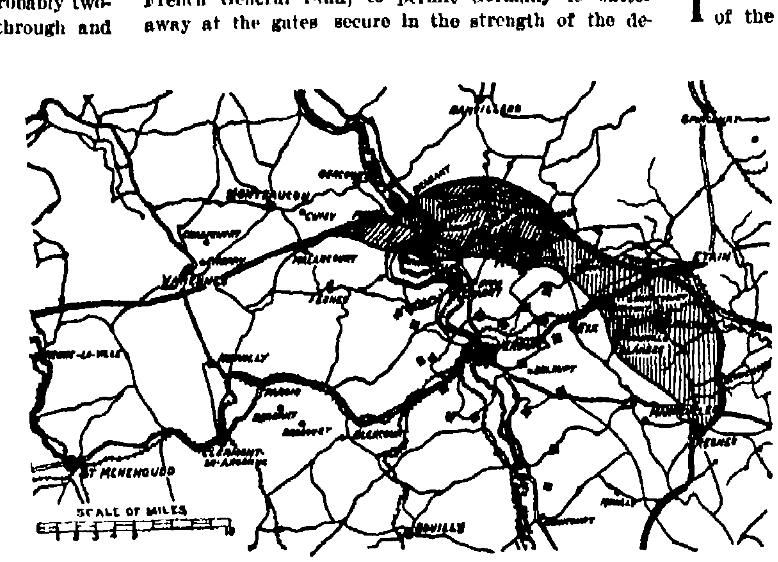
There is another way of defending Verdun, however, beside a mere passive defense—the counter attack. It may be the plan of that wise military council, the French General Staff, to permit Germany to batter away at the gates secure in the strength of the defenses, and wear the attackers away by the process of attrition.

But it does not seem unreasonable to expect the delivery of a counter attack at some other point, possibly to the north, less probably to the south, near Belfort. There is massed now in the vicinity of Verdun the flower of the Kaiser's hosts, veteran corps recalled from the Balkans and from the Russian front. Their places have doubtless been taken by reserve corps where necessary, and while it is improbable that other lines have been materially stripped elsewhere, there probably remains no great body of reserve corps to hurry to another threatened point.

England must have at least a million men on the Continent—more likely a greater number, France must have at least three and a half million men under arms. With the front from the Channel to Switzerland held in the enormous strength of 7,000 men per mile, a most liberal estimate, a million more are still available for utilization in attack.

No one dares say that this will be done, or should be done. France has fought her fight, and fought it magnificently, and with the fragments of detail we possess in this country it would be the height of presumption to pretend to issue self-important dogmas as to what should be done. It is only suggested that at the moment an opportunity seems to exist for a vigorous counterthrust, perhaps upward through the *Champagne*, perhaps eastward through *Artois* and *Picardie* toward St. Quentin and Cambrai, or along the Oise, less probably, on account of the barrier of the Vosges, well to the southward through the trouée of Belfort toward the Rhine valley and Strassburg. At the north a successful break through Dixmude and Ypres would compel the German evacuation of Lille and the section of the line to the southward.

And the other fronts must not be ignored. If Russia has come back, as is currently reported, if Saloniki is held in the force they say is there, the recently organized allied Military Council, the Entente general staff, may call for a concerted effort on every front that will shake the foundations of Europe.



Successive stages in the advance on Verdun, from February 22nd to 28th

Demand for New Peat Fertilizer in England

THE commercial demand for homogen, the new peat fertilizer that is being experimented with in the United Kingdom, is already greater than the supply, according to a report published by the Canadian Department of Trade and Commerce. Offers at $78 per long ton are being made, but the plant available for producing the fertilizer is limited.

Experiments at Kew Gardens and at an experimental station in the Lea Valley have given some remarkable results. Plants apparently dying have been restored to more than normal growth. Four potato sets, weighing a few ounces in all, placed in a small box of moss litter and watered once a week with the extract from bacterized peat, produced three pounds of potatoes in eight weeks. One tomato plant so treated had 16 pounds of tomatoes on it at one time. At the experimental station in Lea Valley 18 cucumber plants treated with manure and bone meal yielded 484 pounds of fruit. Eighteen others grown in 9 parts of ordinary soil mixed with 1 of bacterized peat gave 644 pounds of fruit, 71 pounds being marketed before a single cucumber was ready from the other crop.

Tobacco Fertilizer from Indigo Plant

THE residue of the indigo plant after the extraction of the indican, known commercially as indigo, is used in the Karachi consular district of India, and probably also in other parts of that country, as a fertilizer for the tobacco plant. This substance is known as "seeth."

The roots of the tobacco plant require free access to air. Seeth breaks up the ground in a way to allow the air to penetrate. Experiments have been made recently by the Agricultural Research Institute in Pusa, India, with the object of securing better results from seeth. The substance has been used for years by the natives, but little scientific work has been done in India until the last 10 years. The experiments so far indicate that tobacco soil in which seeth and bits of broken tile or broken chatties (baked-clay water jars) are mixed produces better crops than soil under no special treatment.

The cost of the treatment mentioned above is moderate and the results achieved warrant the extra expense. A plot of tobacco land near Pusa was treated in this way nine years ago and has shown marked superiority over adjoining plots ever since. Indigo has had a remarkable "bloom" since the war began, and the amount of seeth available has increased.

Cleaning Machine Parts Without Use of Benzine

FROM Germany comes the report that machinery and parts of same may be cleaned quite as satisfactorily and perhaps cheaper without benzine or benzol than by the old method. The following is recommended:

The parts of machines should be boiled in soda lye, then brushed while the lye is still hot, and afterwards rinsed in hot water. Caustic soda is recommended as better than ordinary soda, since it causes the fat or grease to dissolve quicker. In order to dry the hot parts it is generally only necessary to let the remaining particles of water evaporate.

Correspondence

[The editors are not responsible for statements made in the correspondence column Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Conserving Public Water Power

To the Editor of the SCIENTIFIC AMERICAN

I write to ask your help to defeat a most serious attack on our public resources Since the fight over the Alaska resources was won there has not been so pressing a threat against the conservation policy as the present effort in Congress to give our public water powers for nothing into monopolistic control.

The Shields Bill, now before the Senate, gives to the power interests without compensation the use of water power on navigable streams. The amount of water power these streams will suppply is larger by far than all the power of every kind now in use in the United States. It pretends to, but does not, enable the people to take back their own property at the end of fifty years, for in order to do so under the bill, the Government would have to pay the unearned increment, and to take over whole lighting systems of cities and whole manufacturing plants. Private corporations are authorized to seize upon any land, private or public, they choose to condemn.

Bills which gave away public water powers without due compensation were vetoed by President Roosevelt and President Taft. The Shields Bill would do precisely the same thing to-day

Another water power bill, the Ferris bill, relating to the public lands and national forests, was in the main a good bill as it passed the House. As reported to the Senate, it encourages monopoly by permitting a corporation to take as many public water power sites as it may please Under it the corporations could not even be kept from fastening upon the Grand Canyon, the greatest natural wonder on this continent This bill takes the care of water powers on national forests from the experienced and competent Forest Service and gives it to the Interior Department, thus entailing duplication and needless expense

In my opinion, there is undue carelessness as to the disposal of public resources at present in Washington The water power legislation now before the Senate is too favorable to the men who, as Secretary Houston's admirable recent report shows, control through 18 corporations more than one half of the total water power used in public service throughout the United States The water power men charge that conservation hampers development. The Houston report shows, on the contrary, that the most rapid development is in the national forests, where conservation is best enforced. On the other hand, 120 public service corporations own and are holding undeveloped and out of use an amount of water power equal to four fifths of all there is developed and in use by all the public service corporations in the whole United States.

As I said in an open letter of January 29th to the President

"Natural resources lie at the foundation of all preparedness, whether for peace or for war No plan for national defense can be effective unless it provides for adequate public control of all the raw materials out of which the defensive strength of a nation is made Of these raw materials water power is the most essential because without electricity generated from water power we cannot manufacture nitrates, and nitrates are the basis of gunpowder There are no great natural deposits of nitrates in the United States as there are in Chile It would be folly to allow the public water powers, which can supply this indispensable basis of national defense, to pass out of effective public control."

A concerted movement is on foot to break down the conservation policy Feeble resistance or none at all is being made by official Washington. Unless the press and the people come to the rescue, the power interests are likely to win. This is a public matter wholly removed from political partizanship Your help is needed, and that of your paper For nearly ten years this fight for the public water powers has gone on. We ought not to lose it now.

GIFFORD PINCHOT.

Milford, Pike County, Pa.

Neutralizing Superfluous Lime in Cement Mortars

To the Editor of the SCIENTIFIC AMERICAN

In one of the July numbers of the SCIENTIFIC AMERICAN you have published an article about the neutralizing of the superfluous lime in cement mortars.

Kindly note that the Dutch engineers and architects have been doing this for many years, however, by the very simple method of adding "tras" to the mortar "Tras" is a puzzolana of first order, and it is obtained by grinding tuffstone. Good tuffstones are found in volcanos. In Europe the best tras is found near Andernach, in Germany, and here in Java on the Moeria volcano.

If tras is added to the cement mortars, the concrete remains even in sea water absolutely intact, and for many, many years its surface will remain as smooth as if new

The reason I write you the above is that in America doubtless tuffstone also is found. MATTHIEU

Soerabaia, Java

The Canals of Mars

To the Editor of the SCIENTIFIC AMERICAN

In Prof Russell's interesting series of astronomical articles he makes the statement that the Canals of Mars can "only be seen with instruments of very high power" SCIENTIFIC AMERICAN, January 29th page 129 This statement is perfectly true with regard to the great majority of the canals, but there are a few that can be seen with a very modest equipment, and, in fact, have been seen here without difficulty in our 3-inch finder with a magnification of 180

Thinking that some of your readers might be interested in looking for them and satisfying themselves of their existence by the most convincing of all possible arguments—that of seeing them for themselves—I have computed the times when two of the most conspicuous ones will be visible in March. They may be seen for a couple of hours before and after the computed times The computation is for Eastern Standard, those using Central Standard must subtract one hour from the figures given in the table, those using Mountain and Pacific Time, two and three hours, respectively

Telescopic view of Mars

1916, E S T

Day	Hour	Minute
Wednesday March 8	6	39
Thursday March 9	7	16
Friday March 10	7	52
Saturday, March 11	8	29
Sunday March 12	9	06
Monday, March 13	9	43
Tuesday, March 14	10	20
Wednesday, March 15	10	57
Thursday, March 16	11	34
Friday, March 17	12	10

With a good 3-inch telescope the difficulty of seeing them depends chiefly on the condition of the atmosphere at the time A high power should be used and a night selected when the stellar images are good and there is little twinkling Great clearness is not necessary and a light haze over the heavens may even be an advantage rather than otherwise The accompanying sketch will give the observer an idea of what should be seen The left hand canal is named Thoth, the right hand one Nilosyrtis, while the very black spot is called the Syrtis Major The brilliant elliptical spot at the bottom is the northern polar cap

WILLIAM H PICKERING

Harvard Astronomical Station Mandeville, Jamaica, B. W I, February 14th 1916

The Need of Organizing Our Resources

To the Editor of the SCIENTIFIC AMERICAN

I have read with extreme interest all President Wilson's speeches made during his recent tour, and the one that I think should appeal to all sober-minded citizens is the one he made at "Kansas City" on February 2nd. I will quote from his speech "Some men in Washington are questioning if we could get the 500 000 men for which the Government is asking" Would they volunteer? Why, I believe you could raise 500 000 men in almost any state. I believe you could get 5,000 men right here in this audience.

We have got voluntary enlistment in America, and in looking at the recruiting tables for the last five years it seems as if the army does not attract many of our young men to the ranks To me this seems perfectly natural The American loves his independence, and he likes to be free at all times to go where and do as he likes but once he joins the army he is held for his time of service and this does not appeal to the average young man

There is not a shadow of a doubt that let the country be in any danger there would never be any lack of good spirited young men to make a large enough army to defend our country and our rights But when trouble breaks out nowadays it does so very suddenly and very often from entirely unexpected directions Let us take an example of Great Britain. She thought herself perfectly protected by her huge navy and still with her voluntary enlistment system she maintained a regular army about equal to our own and before three months of war were over she had lost almost every one of her old enlisted officers and men of the regular army England has had no trouble getting recruits up to a certain stage, and it is not the lack of men so much as it is a lack of organization that has held her back and she has had all her lessons to learn since the war started It must always be borne in mind that once the call for volunteers goes out, thousands of men will leave their work, no matter what it is and join the military ranks for training and it will take many months to get your men so organized as to keep your factories working to their capacity Great Britain has had to recall and replace thousands of men from the trenches who were good tradesmen and who enlisted at the first call, and in this way the whole organization of the country was upset from the very beginning I trust the army observers that we have in Europe are learning all they can about the industrial difficulties as well as the war experiences of the contending armies Of course, we are practically self supporting and that no doubt counts, but events travel so fast that the first few weeks very often count most I will quote a paragraph taken from "The London Times History of the War," January 11th, 1916

"With the outbreak of war came a remarkable rush of recruits to the colors. No better evidence of England's unpreparedness for war can be imagined than the complete lack of any adequate provision for dealing with this rush During the first week of the war pathetic scenes were to be witnessed at the recruiting stations After hours of weary waiting, sometimes in heavy rain it was no uncommon thing for as many as 700 men to be left standing outside one station alone when the doors were closed Nothing could exceed the enthusiasm of the would be recruits On August 10th it was reported that 1,100 men had been enrolled in London alone in the previous 24 hours and that 500 or 600 had been left over Large numbers of reservists applied to extend or renew their service One officer of the new army started with three officers one a young regular and two straight from the officers training corps. Upon them fell the duty one wet night, of receiving about a thousand recruits nearly all quite raw who were deposited by train at the depot There were about 45 to 50 tents ready, but there were no blankets, practically no arrangements for cooking and the new recruits had nothing but their civilian clothes and their enthusiasm Think of it you who have managed a big office or factory you who have organized political campaigns or governed schools and colleges A thousand miscellaneous, unknown men from every class in society from a hundred different trades a hundred different towns and villages of whom a mere handful had the least conception of military discipline and all of whom were glowing with the rather hectic enthusiasm of patriotic self sacrifice In late autumn and winter it rained and round the huts which had taken the place of the original tents the trampled earth turned into loose mud a foot deep which made the camp intolerable"

Now, would it not be a good idea for Congress to appropriate a few hundred thousand dollars and print hand bills to be put up in every post office the bills to be divided off into columns and get every patriotic citizen to enter his name and answer the following questions Age citizen, or not Occupation Have you been accustomed to a rifle If so, what make? Have you got 300 rounds for same? Have you an automobile, if so what make? Age of same Seating capacity Can you handle dynamite? Have you good knowledge of roads, woods trails, water springs, swamps bridges, and natural obstacles within 10 miles of your home? Can you ride and drive? Have you telephone connection? Would you be willing to attend a week's field drill every year in your district? Would you be willing to enlist your services in case of need? If so apply to (name nearest recruiting offices) Now as this is a voluntary army system what better way is there of finding out just where your willing men are and to keep them in touch Then if they left that district to advise the postmaster and then re-enter their names at their next town or village I am sure the thousands of officers from the military academies would take delight in giving men a week's drill in marching trenching first aid etc There is not a finer body of men in the world for material for soldiers The average American is a good shot, can camp anywhere, and a great number of the country workers are expert bridge makers and dynamiters Let us take our lesson now, and at all costs let us be prepared not by only having an army of 500 000 men but by having the whole country and resources organized Let this be the first plank in every political platform The absolute safety of our country Be prepared.

E ANDERSON

Sebago Lake

Modern Bread-Baking

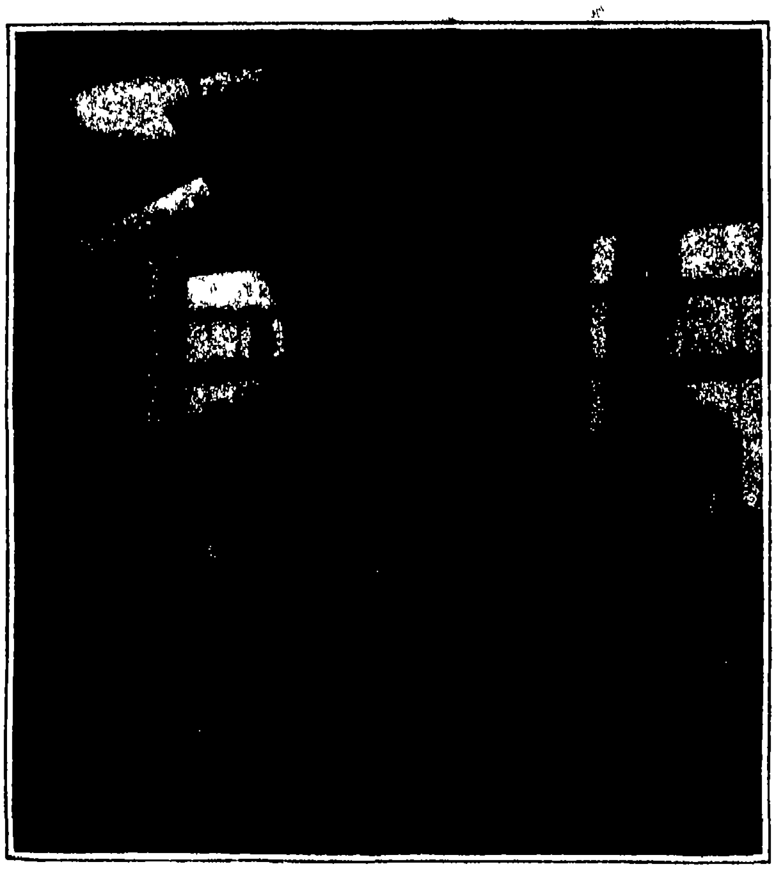
The Loaf Untouched by Human Hands in the Process of Making

THE baking of bread from flour or parched grains by means of heat is the most ancient of human arts. Calcined remains of bread, made from coarsely ground grain have been found in the Swiss Lake dwellings. Egyptians during the reign of Herodotus baked elongated loaves of bread which had curiously enough seeds sprinkled on the top like our modern rye breads. In the excavations of Pompeii loaves of bread were discovered round in form and stamped with the baker's name. Bolters for sifting flour, dome shaped ovens and peels for charging and discharging the ovens, not unlike those used by bakers to-day have also been excavated from the ruins. It is remarkable that an industry producing such an important commodity as bread, and an industry old as civilization itself should have developed so slowly until comparatively recent years.

Probably no other trade has made such slow progress as had the baking industry up to the last quarter of the nineteenth century. However during the last 25 years it has made marvelous advancements through the use of automatic machinery and the scientific developments of its processes. A few years since it was estimated that 20 per cent of all the bread consumed was produced by the baker—the other 80 per cent being baked in the home. This condition is rapidly changing and in the very near future at least 80 per cent of all the bread baked will be produced in modern sanitary bakeries. Recent inventions and scientific discoveries, the establishment of sunlight bakeries with their scrupulous cleanliness, the sanitary handling of the finished product and the modern system of delivering fresh bread each day naturally enough stimulate the increasing demand for baker's bread. The popularity of the bread will continue to increase because of the constant improvement of the product, due to the baker's better knowledge of fermentation, better knowledge of all the ingredients entering the loaf, more sanitary methods of production, and because of the absolute cleanliness in the handling of the baked loaf.

The modern baker uses an absolutely pure uniform grade of flour, pure compressed yeasts (instead of the uncertain ferments which cause sour and otherwise undesirable fermentation), pure water and the best available material for shortening, dough kneading machines, regulated so as to produce uniform mixing and a uniform temperature of the dough, devices for maintaining a uniform temperature and humidity of the fermentation room, and complete automatic machinery for scaling the dough into loaves, molding them into the desired shape, placing them into pans and conveying them into the oven and out again. He has also recognized the value of the wrapping machine which wraps each individual loaf in germ proof paper, keeping it absolutely pure and clean until it reaches the consumer.

The greatest triumph for modern baking has resulted in the development of a completely automatic plant, by which the bread, during the process of manufacture, is positively untouched by human hands. This achievement is all the more noteworthy because of the difficulties that were overcome in constructing a machine that would handle such a plastic and everchanging mass as the loaf in its formation.



Discharging a batch of dough from the kneader into a trough in which the dough is left to rise

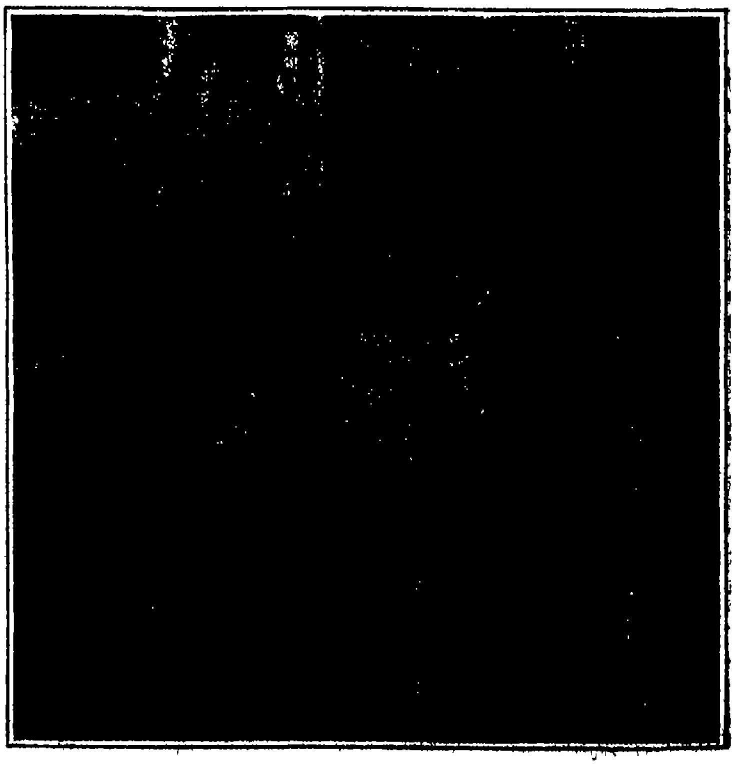
This automatic plant increases the capacity of the bakery, lowers the cost of production, insures the utmost cleanliness for the finished loaf, and produces a pure, uniform, nutritious and wholesome loaf of bread.

Of no little interest too, is the manner in which the raw materials are handled before reaching the automatic plant. The flour on arrival is usually stored in a cool, dry, well ventilated basement for three or four weeks to condition and give it the proper age. When ready for use, it is dumped into a hopper to be conveyed to the top floor of the building where it is delivered to the blending and bolting machines which thoroughly mix it and, at the same time, remove from it, wood, nails, fiber, etc., before it is automatically weighed into the kneading machine. The other ingredients—water, sugar, shortening, salt, malt, milk and yeast, that finally become the finished loaf—are also weighed automatically into the kneader which works and churns them thoroughly into a uniform mass of dough, absolutely the same throughout in temperature and composition.

A continuous blast of cold washed air passes into the mixer and acts upon the dough during the mixing. This whitens the dough materially, aids in developing the gluten, and cools the dough which would otherwise become too warm under the high speed mixing. The dough is mixed 15 to 25 minutes and is then discharged from the kneader into a trough, where it is left to rise three to five hours in a room abundantly supplied with sunshine and fresh air and the temperature under perfect control. During the rising the dough becomes permeated with carbondioxide gas and the glutinous material is highly developed so that it produces a loaf of maximum value. The matured dough is then dropped through a chute into a hopper below ready for the automatic plant.

The hopper delivers the mass of dough, often weighing over 1,500 pounds, to the dividing machine, which scales off six loaves at a time and always of uniform weight. These six loaves are then delivered to the rotary turning in machine which molds the dough into a round mass and at the same time closes up the pores of the dough by putting a soft outer skin upon it. This prevents it from sticking to the boxes of the first proofer into which it is dropped. The proofer consists of an endless series of boxes, six each, and each canvas-lined. Here the dough, through oxidation and loss of moisture, develops a soft outer skin making it possible for the rounding up machine, which receives the loaves automatically from the first proofer, to mold the dough perfectly into a round ball. The dough comes from this machine completely closed with a firm outer layer and passes continuously to the second proofer by a conveying belt which drops it into an endless conveyor provided with canvas lined boxes (six abreast). Here the dough remains, each

Dough rising in a well ventilated sunlit room



Automatic dough divider with hopper and rotary turning-in machine

piece in its individual box, but travels continuously for fifteen minutes, expands and recovers completely before it is automatically delivered in regular succession to the molding machine. This machine molds the loaves and automatically places them into pans, which in turn are conveyed to the steam proofer The dough now expands to the desired height in the open pan before entering the oven to be baked The steam proofer is so constructed that any desired degree of humidity or temperature can be attained. When the plant is in full operation the proof box carries 4,000 loaves and is never empty—loaves enter continuously at one end and pass out at the other, ready for the oven.

This brings us to the final step of the automatic plant—the traveling oven. This is the most wonderful achievement of the whole process The loaf of bread which, up to this stage has been kept so scrupulously clean and pure and developed to the highest degree possible under modern scientific methods, now goes to the oven for its completion into a nutritious and wholesome loaf

It is truly a wonderful sight to see the continuous stream (5,000 every hour) of unbaked loaves automatically enter the traveling oven at one end and emerge from the other perfectly baked loaves, most attractive in appearance with their golden brown color and characterized by their uniformity of size and composition Every precaution necessary for the production of a perfect loaf has been taken in constructing this oven. The top or bottom of the loaf can be baked more thoroughly, if conditions so require, by merely pushing or pulling a damper Steam can be injected or withdrawn from the oven at will and, by pressing an electric button the speed of the oven can be increased or decreased.

The nice, crisp, well browned and thoroughly baked bread is then—as it comes from the oven—conveyed to another floor, usually below Here it travels continuously on canvas belts until it is thoroughly cooled, before being wrapped by wrapping machines, which wrap each loaf with a dust-proof and germ proof wrapper This insures for the consumer a clean, pure and wholesome loaf of bread.

The advent of the automatic baking plant adds another decided improvement for the production of better bread. It comes rather opportunely since, at this time, the public is demanding cleaner, purer and more sanitary food products. The modern baker realizes this condition and is ever ready to meet it by installing such devices which will improve his product The rate at which the automatic plant is being installed in this country is truly astonishing—over fifty have been installed within the last five years. A New York company was the pioneer in this field and was the first in this country to adopt it just as it was the pioneer in establishing sunlit and well ventilated bakeries, and mechanical devices for keeping the bread absolutely pure and clean during the process of manufacture. It was also first in maintaining research laboratories for developing the science of bread-making.

Automatic rounder-up and proofer handles the dough in a human-like way

The baked loaf being automatically discharged from the traveling oven

Wrapping machine which wraps each loaf with germ-proof and dust-proof paper

The Current Supplement

THE frontispiece illustration of the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2097, March 11th, 1916, is an interesting picture showing the construction of a large sewer that was built of reinforced concrete, the valuable material that is being so widely adopted in place of brick and stone masonry, and which is being applied to so many purposes. The accompanying article, which is illustrated by diagrams, shows some structures in which reinforced concrete has been employed and how it is used. Another article describes and illustrates how the large amount of concrete required for the extensive foundations of the new Field Museum, in Chicago, was handled. The two articles are quite characteristic of modern engineering methods. *The Structure of the Earth* is an able paper on a subject in which interest will be undiminished for many years to come. *Ocean Temperatures in the Vicinity of Icebergs* tells of some investigations made with a view of making possible safer ocean navigation, and includes the examination of the salinity of sea water and the detection of bergs by echoes. *American Built Locomotives Abroad* describes and illustrates a number of machines of different types that have been recently built in American shops for foreign users, showing interesting composite designs. The paper on *The Importance of Geographical Research* is concluded. *The Calorimeter as an Interpreter of Life Processes* is a brief study of the fuel requirements of the human individual in health and in disease. *The Development of Military Small Arms* briefly reviews the history of portable fire arms, and is by a recognized authority on the subject It is fully illustrated. *Concussion Blindness* describes a serious trouble resulting from the nearby explosion of heavy shells and mines, which has come into prominence of late in the war areas of Europe. Other valuable articles in this issue are *The Uses of Tungsten, Automatic Looms Currency in China, Pasteurized Milk in the United States* and *Gelatine as a Food for the People*

Compressed Paper for Shoe Soles in Germany

IT is reported on reliable authority that on account of the scarcity of leather a substitute consisting of compressed paper with a thin leather covering has been used for shoe soles in Germany The price of this product is given as 70 cents per pound and the wares have been advertised as being considerably cheaper and more lasting than leather It has been ascertained that this advertisement however, is not correct and the public has been advised accordingly Unscrupulous dealers using these paper soles have been warned against misleading the public

In a recent meeting of the Board of Guilds in Liegnitz it was claimed that raw hides are cheaper now than before the war, although a pound of leather still costs $1 66 to $1 90 The enforced slaughtering of cattle and the opening of new sources of supply have added to the leather stock of Germany thus maintaining comparatively moderate prices for this commodity

Contest to Improve Housing Conditions of Immigrants

WITH the aim of arousing interest in the subject of housing conditions of immigrants in industrial towns, as well as to produce carefully worked out and entirely practicable housing plans and standards which it will be possible for employers and workmen and communities alike to demand and insist upon there has been inaugurated a housing competition and public exhibition under the auspices of the National Americanization Committee with the coöperation of the various societies and institutes of architects and engineers

Prizes aggregating $2 100 are offered for plans, sketches grouping and arrangement, for the housing of immigrants in industrial towns. The prizes are divided into two groups. The first covers plans for the housing of workmen in industrial communities not exceeding a population of 35 000 Entries in this class include plans for (1) single family houses, (2) combined family and lodging houses, which will permit separation of the family from the lodgers, and (3) boarding houses or community dwellings for numbers of single men or of single women The second group offers prizes for a satisfactory substitute for the derailed freight and cattle cars now used to house construction gangs on railways

In announcing the competition, the Committee calls attention to the fact that new communities clustered around new industries are being produced in this country with phenomenal rapidity It is the small industrial town at present, not the large city, in which the "congestion" problem of the country is centered Men flock by thousands to places where there are plenty of jobs—but no dwellings.

Norwegian Canners to Manufacture Tin Plate

THE fish canners of Stavanger, Norway, who have been trying to become independent of foreign countries for their supply of tin plate, have been successful in their attempts to secure sufficient capital for the erection of a rolling mill in their city

More than 30 000 tons of tin plate are used annually in the Stavanger district alone. The plans for the new mill will provide for yearly production of at least 30 000 tons This enterprise will cost more than $1 000 000 and will employ 100 to 500 men The electric machinery to be installed will produce 1 000 horse-power, but the maximum production will probably not be reached for three or four years. No attempt will be made to begin construction until after the close of the European war because of the difficulty of obtaining raw material

The Naval Losses of the Germans and their Allies

A [illegible] Major War Vessels Lost by the Central Powers

[The Naval losses of England and her Allies were shown in our last issue.—EDITOR]

THE opening of the great war found Germany the second naval power in the world. However, the ranking is deceptive in that the actual fighting value of her fleet was scarcely one half that of the English fleet. The addition of the fleets of the several Powers engaged to that of the main naval contestants has not perceptibly changed this proportion.

With that logical and painstaking reasoning that has distinguished every German military effort, it was decided not to dispute the mastery of the seas with the disproportionate forces available, but to dispose them in certain other lines so as to more nearly employ the total enemy forces under hazardous conditions.

Such naval actions as have occurred where disproportionate forces were engaged have resulted in the practical annihilation of the weaker antagonist and demonstrated the wisdom of the policy adopted.

At the outbreak of the war the Germans found themselves with important ships in two localities where they were blocked off from home ports. In the Mediterranean the "Goeben" and the "Breslau" were hard pressed by both the French and the British fleets in those waters. They successfully eluded their opponents and reached the then neutral waters of Turkey without an engagement.

In subsequent operations with the Turkish fleet around Constantinople and in the Black Sea there have been numerous reports of the destruction or serious damage of these vessels. These reports have not been confirmed.

In the Pacific there was the cruiser squadron off South America. The first engagement of their own choosing resulted in the destruction of Admiral Cradock's cruiser squadron. The English then dispatched a squadron under Vice-Admiral Sturdee, which finally encountered the Germans off the Falkland Islands and sunk the "Scharnhorst" and "Gneisenau" armored cruisers, and the light cruisers "Leipsic" and "Nürnberg." The "Dresden" was driven back to the Pacific, where she was finally destroyed.

The remaining war vessels of Germany unable to return home were employed as commerce destroyers until destroyed or interned to avoid engagement with enemy war vessels. The spectacular character of their work and the fact that American citizens, American vessels and American merchandise were involved in the captures caused special interest to be taken in the careers of these commerce raiders. The "Emden," "Karlsruhe," and "Kaiser Wilhelm der Grosse" were sunk while engaged in this work. The converted cruisers "Prinz Eitel," "Frederick" and "Kronprinz Wilhelm" sought refuge in Hampton Roads and involved considerable diplomatic negotiation on the part of this country until finally interned.

Eventually all of the vessels engaged in this work were disposed of.

The first offensive naval effort on the part of the Central Powers in home waters consisted in the sowing of mines. Several of the mine layers were lost in this operation, the principal one being the "Königin Louise."

The enemy ships destroyed by mines and the restriction of navigation effected, amply compensated for the losses sustained.

Naval operations in the Baltic find the situation reversed with the Germans dominating. In the operations there the cruiser "Madgeburg" was lost, and it is reported but not confirmed that a battle-cruiser of the "Moltke" class was torpedoed in the attack on Riga in conjunction with the land operations for the capture of this point in the great drive of last year. If true, this would form the most important naval loss of the Central Powers. In the Turkish naval operations the success of the land fortifications and mines was offset by the sinking of the battleships "Messudyeh" and "Barbarossa" by submarine attack, and the loss of the "Mejidieh" by a mine.

The major losses in the Black Sea were in Turkish troop ships.

The attempted raids on the English coast were stopped by the destruction of the "Bluecher" and the injuries to the battle-cruisers whose speed was sufficient to render such a raid possible. However the chances are that they would have been discontinued because the damage possible to inflict was so small compared to the risks involved.

The attacks on the part of the English on the German fleet at its bases have resulted in the destruction of the battleship "Pommern" and the protected cruisers "Mainz," "Köln" and "Ariadne."

The major naval efforts of the Teutons have been in the submarine campaign directed mainly at commerce. It is probable that the protection afforded the Allied high sea fleet and transport service by their auxiliary service has prevented a greater toll of war vessels.

The auxiliary patrol service has been very effective, and the number of U boats destroyed has been variously estimated at from thirty-five to seventy-five. Whichever total is correct the initial activity on a large scale has been followed by a period of comparative quiet. In recent times the Mediterranean has offered the best field for their activities, due to the immense problem of troop transport for Gallipoli, Saloniki, Egypt and Mesopotamia.

The announced intentions of the German government would indicate that a sufficient number of submarines was again available to pursue with vigor the campaign against commerce which had temporarily lapsed.

In the naval war both sides have shown great daring and ingenuity. The greatest possibilities for property destruction rest with the Central Powers, owing to the amount of ships of the enemy exposed to attack and the difficulty of protecting the vast expanse of water which is utilized for this commerce.

The present status of naval operations leaves the Entente in control of the situation, with the Central Powers mainly endeavoring to harass and destroy commerce which the Entente control renders possible.

A large number of smaller vessels of little military value and numerous destroyers have been sunk in the occasional encounters in the various theaters of naval operations.

A complete list of all vessels lost forms an imposing total for the contestants on both sides of the struggle. Of the casualties known and reported the Entente Allies have the larger number of more important ships. However, the Central Powers have not reported any vessels damaged from internal or external cause except where engagements with the enemy have occurred. Also, numbers of Central Power vessels are listed as sunk on the official reports of their enemies only.

Altogether, the offensive power of the contestants has not been materially changed due to the casualties incurred in carrying out their naval warfare. The real and important changes in this respect are the vessels which have been added to the fleets since the outbreak of the war. There has been great activity in warship building. There have been important departures in types and construction due to the lessons the various actions have taught. But of the numbers built or the departures made very little has been permitted to filter through to the outside world.

A New Use for the Seismograph

By Robert G. Skerrett

THE seismograph as a means for determining the duration and the violence of distant earthquakes has served its purpose for a long time. Latterly, a series of these have been so employed that they could locate by triangulaton the approximate source of the disturbance. This, of course, being deducted from common knowledge of well-established "faults" in the earth's crust. Through these combined agencies earthquakes thousands of miles away have been spotted, so to speak. But now comes a far more novel adaptation of seismological instruments, this time as a military aid.

Prof Belar, an Austrian scientist of repute, and for the past 20 years an investigator of seismological problems has had recourse to his special instruments to record the earth shocks due to gunfire. It just so happens that his work of latter years has been at Laibach where he has been in charge of the seismic observatory. Now Laibach is about 50 miles away from one section of the Isonzo front where the Austrians and the Italians have battled so desperately. There some of the heaviest artillery duels have been fought, and knowing something of the awful might of modern ordnance it is not surprising that the sensitive instruments at the Laibach Observatory have felt and recorded some of the tremors that have passed through the earth after each bombardment.

Prof Belar has watched his seismographs day by day as the struggle raged and through them he has been able to give the world the first "autographic war records" born of earth shocks following the firing of heavy artillery. Such readings may not seem at first blush to have any practical value, but we are informed that from a military point of view the facts are quite to the contrary. The seismograph has really proved to be a sort of scientific spy and capable of telling immediately things of the utmost importance about the enemy's strength and the distribution of his batteries. This is really the climax of an extensive series of experiments.

About eight years ago, Prof Belar approached the Austrian military authorities and laid before them a scheme for the military use of the seismograph. At the instance of Archduke Leopold Salvator, Inspector-General of Artillery, tests were promptly undertaken, and the results were decidedly astonishing. The first measurements for determining accurately earth shocks due to artillery fire were made at Gurkfeld, in June of 1907, with especially constructed instruments. In order to get as complete a series of records as possible, the seismographs at that time were placed at different ranges from the guns and howitzers. Topographical conditions were also taken into account. The graphic records disclosed a marked difference between the shocks following the discharge of the weapons and the impact of the projectiles. The tremors induced by the "kick" or recoil of the piece are commonly recorded in the form of short waves which look something like the last three letters of the word "shift" written by hand, while the wave motion resulting from the explosion of a projectile on impact is much longer and has the serrated appearance of a hastily penned "unwritten." It was found possible even to distinguish the direction of the source of the vibrations and also to establish the caliber of the gun if the observer of the seismograph had available a comparative diagram based on previously studied effects of different sized weapons.

The apparatus now employed by Prof Belar, which is hardly bigger than a typewriter and easily carried about, is so responsive that the inventor is able to identify any street noise and by a glance at the record can tell whether the cause of the registered wave was a cab, a team of horses, artillery drawn through a distant street, or a train of cars. The records are such that a person once familiar with them—like a stenographer's notes—can see at once what caused them.

It seems that Prof Belar can readily distinguish the earth shocks occasioned by Austrian guns from those produced by the foe's weapons. That the modern mount of siege pieces and the like do not materially lessen the blow delivered to the earth is proved by the fact that the recoil of the present-day gun is hardly less noticeable than that of the weapons supported on the older carriages. This is something of a revelation. Again, it seems that the apparatus is capable of making a record which is a visible index of the number of guns employed on any firing line.

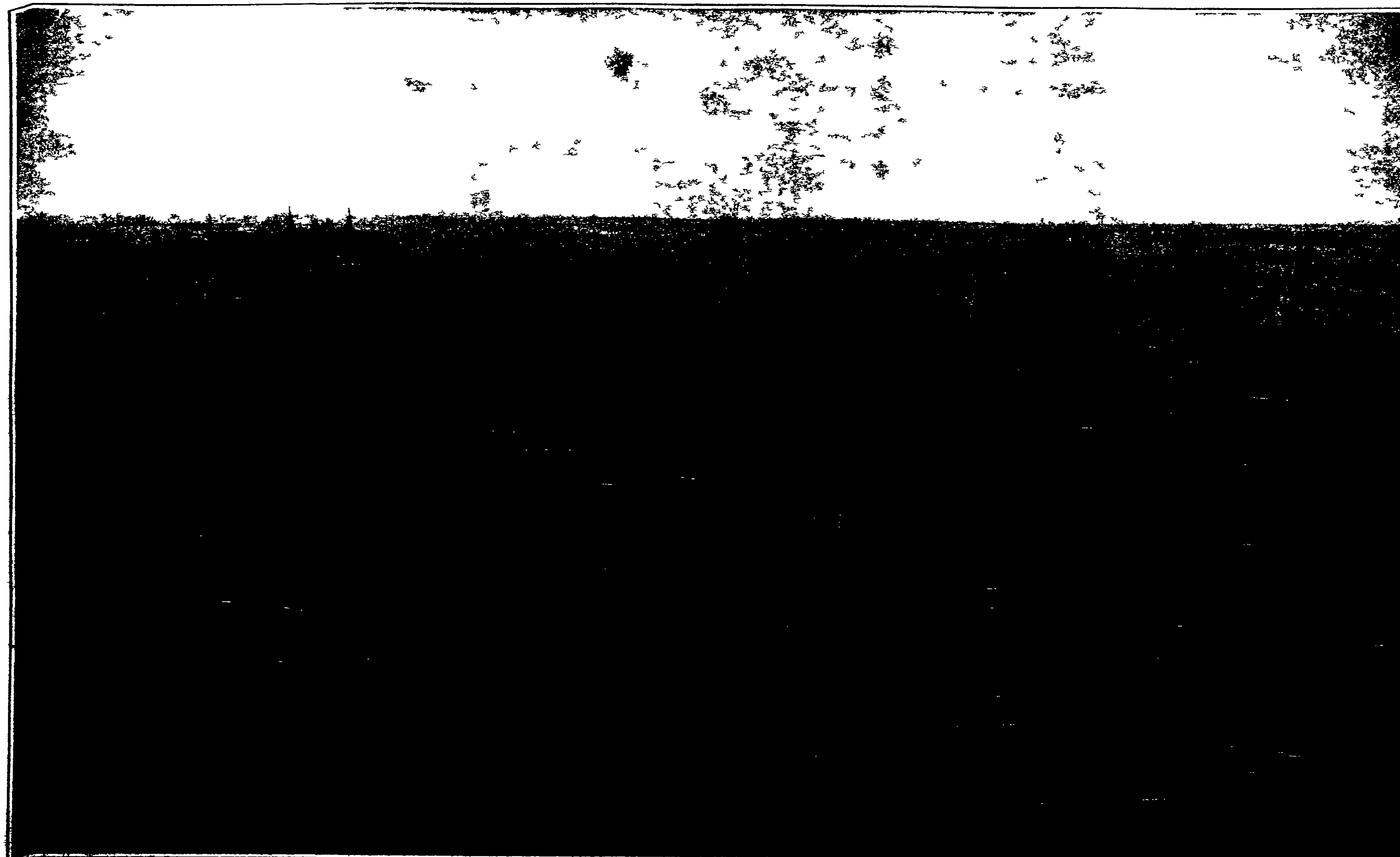
Of course, the Laibach Observatory is too far removed from the Isonzo front to make legible records of the sort just described, because the observer, for that purpose, must be within 35 miles of the firing line and, at the same time, should be in telephonic communication with his own artillery so that he can isolate the wave records made by the foe's ordnance. Such is the general character of the apparatus which Prof Belar has constructed for field service. It seems to be well established that the Austrian authorities are very favorably impressed, and well they should be, for what is more important than to be able to locate the enemy's batteries and to determine the number and the caliber of guns thereof? The study of earthquakes has in this case led to both a novel and an extremely ingenious adaptation of the seismograph.

Prof Belar has gone still further, and a modification of his apparatus is used for the detection of the approach of enemy craft, and especially for giving warning of the coming of submerged submarines. In this field he has recourse to a "feeler," as he calls it, carried well out from the shore and placed under water—the "feeler" connecting with the detector or seismograph on land. The vibrations set up by the beats of the propeller of the advancing vessel are picked up by the "feeler," and the character of the wave-records on the recording cylinder serve not only to distinguish broadly different kinds of vessels but to locate their positions and distance away.

Cheap Fireproof Roofing in Demand in the Philippines

A CORRESPONDENT writing to the *Commerce Reports* from Manila recently states that the problem of a cheap roofing material which will be fireproof and suitable to replace nipa and grass—the roofing materials of the poor in the Philippines—has not yet been solved. There are many acres of short-fibre asbestos in the islands, but as yet no machine or process has been developed for turning this raw material, which is in very accessible places, into suitable roofing.

A local cement factory turns out a good product, and the asbestos beds are on the same island. Modern machinery to work the combined material into required lengths and thickness, as well as the process for making the combination, is wanted.



WAR VESSELS LOST BY GERMANY AUSTRIA AND TURKEY DURING THE PRESENT WAR, UP TO MARCH 1st, 1916

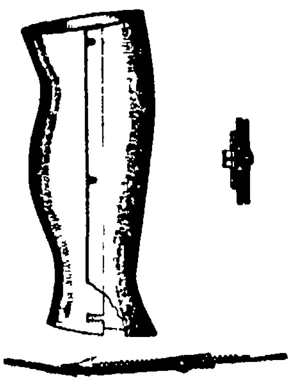
1. *Blücher.*
2. *Scharnhorst.*
3. *Gneisenau.*
4. *Yorck.*
5. *Prinz Adalbert.*
6. *Friedrich Karl.*
7. *Mainz.*
8. *Köln.*
9. *Emden.*
10. *Dresden.*
11. *Nürnberg*
12. *Barbarossa,*
13. *Medjidieh.*
14. *Messudyeh.*
15. *Kaiserin Elisabeth,*
16. *Zenta.*
17. *Bremen.*
18. *Koenigsberg*
19. *Leipzig.*
20. *Ariadne.*
21. *Undine.*
22. *Jaguar*
23. *Iltis.*
24. *Tiger*
25. *Luchs.*
26. *Cormoran.*
27. *Albatross*
28. *Hela.*
29. *Kaiser Wilhelm der Grosse.*
30. *Cap Trafalgar*

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

LEGGING.—C. F. ROGERS, Box 334, Covington, Va. This invention relates to leggings for military and other purposes and has reference more particularly to a legging which comprises a body having an underlying and an overlying part, the parts having co-acting locking members, both concealed by the over



LEGGING

lying part. The legging can be used by soldiers, equestrians, hunters and others, is capable of the uses to which leggings are ordinarily put, is strong and durable, is light in weight and is comfortable when worn and attractive in appearance.

MATERNITY SKIRT.—G. BAER, 510 6th Ave., New York, N. Y. In this class of skirts it is necessary to alter the appearance either by the gradual enlargement of plaits or by destroying the location of certain arrangement of the fabric and thus destroying the original balanced effect of the skirt or for other reasons, and it was in order to overcome this that the invention was conceived.

Electrical Devices

PROTECTING DEVICE FOR ELECTRIC CONDUCTORS.—M. H. LOUGHRIDGE, Pleasant Place, Teaneck, N. J. This invention relates particularly to the ends of conductors which are led under ground, and provides a device which will form an efficient shield for the end of the said conductor at the point where it emerges from the ground, and prevent the same from being injured and guard against the admission of water to the conduit or other covering of insulation in which the conductor itself is located.

Of Interest to Farmers

BEET HARVESTER.—A. F. DIJSBERG, Consul, Saskatchewan, Canada. This invention provides a vehicle having means thereon for topping the beets, means for raising the beets out of the ground, means for conveying the beets to a hopper, means for conveying the tops to a basket, means for discharging the beets and tops in separate piles at desired times and means for rendering the parts in operative at will.

Of General Interest

STREET INDICATOR.—H. W. VERNSON and R. F. LUTZ. Address Carroll D. Smith, Blue Rapids, Kan. A card holder is provided having separate cards bearing the names of different streets. The cards are supported to drop by gravity to a position to bring the street name thereon into view. The cards are sustained by movable supports adapted to be actuated by electro-magnets to release the cards, and co-acting selective devices are provided on the trolley and along the conductor to energize the magnets for controlling the respective card supports. The cards are restored to their original positions by lifting means which in the preferred form comprises an air cylinder and a piston. Valve means are under control of electromagnets automatically energized at the proper time.

REFILLABLE POWDER PUFF.—KATHERINE K. BAKELAAR, 239 Main St., Passaic, N. J. This invention provides a puff arranged to permit the user to fill the puff with any kind of face powder of the user's choosing, to prevent the powder from coming out too freely, and to allow the user to readily apply any desired amount of powder to the face and to rub it over the desired space on the face.

FRONT SIGHT.—N. BISNER, Glencove, Wash. This invention relates to guns, rifles and other firearms and provides a new and improved front sight arranged to permit the user to take correct aim during the dawn or in dark forests or under other conditions in which the ordinary front sight becomes indistinct.

DESK.—H. E. BENNETT, Williamsburg, Va. The invention relates to desks, especially those which are used for school purposes. It provides a desk which may be easily adjusted at various inclinations, and which is supported at one end. The desk has novel supporting and guiding means for the adjustable desk top or writing surface.

BUILDING BLOCK.—W. J. GRONERT and W. C. REID, care of Elkhart Musical Instrument Co., Elkhart, Ind. The invention is an improvement in building material and has particular reference to a novel construction of plastic block. The block is so constructed with tongue and groove fittings that a wall may be erected and perfectly alined without the necessity of employing a skilled mason.

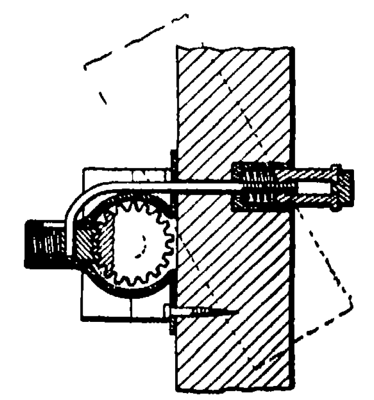
FLUE STRUCTURE.—G. C. ROYSE, 5006 S. Prospect St., Tacoma, Wash. The improvement refers to flue structures and more particularly to one embodying a flue lining and blocks so formed as to be readily incorporated into the structure and readily fitted around the flue lining in a novel manner to receive a binding material securing the blocks together and to the flue lining.

COLLAPSIBLE CORE FOR CONCRETE CULVERTS.—A. E. CAMBLIN, Stella, Neb. The present invention relates generally to collapsible cores for concrete culverts adapted in use to freely support mold boards upon which culverts or like structures are erected of concrete or plaster materials of this nature, the primary object being to provide certain improvements in devices of this character, particularly over this inventor's co-pending application, No. 715,322, and Patent No. 1,142,069.

Household Utilities

COLLAPSIBLE FORM FOR CISTERNS.—C. L. CRAIG, Lock Box 403, Washington Court House, Ohio. This invention relates particularly to sectional adjustable molds utilized in the formation of water storage cisterns and other structures of this character, and the primary object is to provide an arrangement by which a cistern may be constructed of cementitious material within the ground without the use of bolts, nuts and special tools and without the use of calculating instruments or skilled workmen.

MIRROR LOCK.—S. F. COSS, 1805 Pacific St., Portland, Ore. The main object of this invention is to provide a mirror lock adaptable



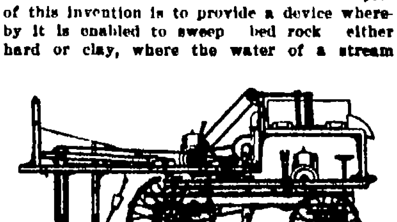
MIRROR LOCK.

to all styles of dressers having a swinging mirror which will lock the mirror at any desired angle and which will be simple but positive in its action. A further object is to provide a device which will be inconspicuous upon the dresser frame and so not detract from the appearance of the dresser.

LIQUID SOAP DISPENSER.—A. G. CARLING, 110 W. 64th St., New York, N. Y. This invention has reference more particularly to a device which comprises a reservoir for liquid soap or the like, an ejector communicating with the reservoir and operable at the will of the user to dispense soap from the reservoir and means for so mounting the reservoir and the ejector that on a predetermined position thereof the ejector is inoperative.

Machines and Mechanical Devices

SWEEPING DREDGE.—H. R. WALKER, P. O. Box 322, Nome, Alaska. The main object of this invention is to provide a device whereby it is enabled to sweep bed rock, either hard or clay, where the water of a stream



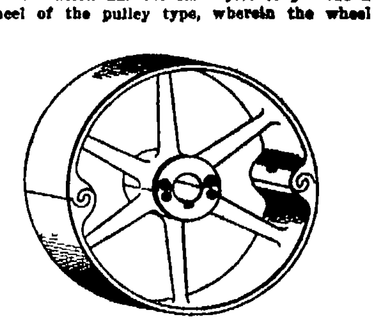
SWEEPING DREDGE

is not of a prohibitive depth and whereon gold or other placer mineral has been deposited by the action of the water. It also provides means whereby the sweepings may be drawn by a concentrator or amalgamator, or suitable containing means by suction.

COIN TRAY AND LOCK MECHANISM.—E. Fox and R. S. Fox, York, Pa. The invention relates to a coin tray and lock mechanism of the kind suitable for enabling a number of persons to severally produce different amounts they have collected, readily count the same and place the amounts thus counted in convenient shape to be counted subsequently by another person and in the meanwhile to keep the money fully protected.

LUBRICATING PULLEY.—H. G. VANCE, 4281a Moffit Ave., St. Louis, Mo. This invention relates to means for lubricating pulleys applicable to various forms of such pulleys, wherein the lubricating member is required to be locked to the shaft of the pulley. The primary object is to provide a lubricating member with means which automatically prevent its rotation within the pulley and obviates the necessity of set screws or other fastening members for securing the same to the shaft.

WHEEL.—S. MICHAUD, Cleveland, Maine. The invention has for its object to provide a wheel of the pulley type, wherein the wheel



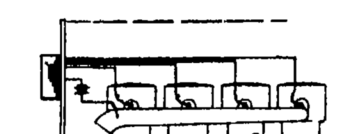
WHEEL.

comprises a hub, a rim and spokes connecting the hub and the rim and is composed of sections, the hub portions of the sections having interlocking mechanism for preventing movement of the portions longitudinally of the axis of the wheel, and the rim sections having interlocking mechanism for preventing circumferential displacement of the sections with respect to each other.

Prime Movers and Their Accessories

PISTON RING.—L. R. HICKS, Hallsville, Mo. The invention provides a ring which while flexible contractible and expansible to permit its easy insertion and removal will yet make a fluid tight joint both between the piston and the cylinder walls and between the ring and the piston, and wherein the arrangement is such that there is nothing to score or cut the cylinder wall during the reciprocation of the piston.

EXPLOSION INDICATOR FOR INTERNAL COMBUSTION ENGINES.—C. T. HAAS, Tucumcari, New Mex. This invention relates more particularly to indicators utilized in connection with automobile and other engines

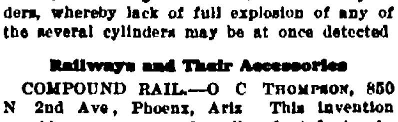


EXPLOSION INDICATOR FOR INTERNAL COMBUSTION ENGINES

for indicating the explosions of each of the several cylinders of a multi-cylinder motor, the object being to provide an indicator with means for operating the same under actuation of the exhaust gases from the several cylinders, whereby lack of full explosion of any of the several cylinders may be at once detected.

Railways and Their Accessories

COMPOUND RAIL.—O. C. THOMPSON, 850 N. 2nd Ave., Phoenix, Ariz. This invention provides a compound rail adapted to be easily assembled and disassembled for removal



COMPOUND RAIL

of worn parts, and adapted to be maintained in locked position by action of the car wheels passing over the rail. It provides a compound rail including a resilient filler upon which a tread portion in the form of a cap or facing plate is locked, said cap or facing adapted to be removed when worn.

CLAW BAR.—J. G. VINSON. Address W. G. Duncan, Jr., care of W. G. Duncan Coal Co., Greenville, Ky. The invention provides a bar wherein a lever or handle portion is provided having a claw for engaging a spike and having pivotally connected with the end adjacent to the claw a shackle having a hook for engaging the tie, and having a convex rocking surface between the heel and the claw, the pivotal connection between the shackle and the lever being adjustable to permit the relative arrangement of the shackle and the lever to be varied.

Designs

DESIGN FOR A SOCKET COVER AND GLOBE FOR ELECTRIC LIGHT FIXTURES.—B. SCHWARTSMAN, 15 Laight St., New York, N. Y. Mr. Schwartsman has also invented new, original and ornamental designs for the following cases: Design For A Canopy For Electric Light Fixtures; Design For An Electric Light Casing; Design For An Oval Back For Electric Light Fixtures.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Don't Blame it All on the High Price of Gasoline

THE COST of running the average motor car is making even the careless man think.

The average dollar spent for fuel delivers *less than 15 cents' worth of ride*—85 cents is burned up in friction, dead weight and complicated mechanism—35.9 percent. is wasted in cooling the motor alone.

The radiator of the average car weighs 75 lbs; the water, 48 lbs; fan, piping, pump and the rest of the 177 water-cooling parts add more weight.

This means *more horse-power* in the engine to move the car. More horse-power means *heavier engines* and a heavier engine means *heavier weight* throughout to carry it.

The average water radiator contains 5,000 cells and 6,000 to 10,000 soldered joints, to say nothing of the bladed fan, geared water pump, hose, piping and pipe connections—all costing money for maintenance, for care and attention.

The automobile is a mechanism of which *every part* does some work. It may not rotate, but through jar and vibration over the roads there is *friction loss.*

The Franklin System of Direct-Air-Cooling does away with all these encumbrances, friction, dead weight and complication.

The Franklin Automobile, under practically all conditions of driving, delivers *more mileage* per gallon of gasoline than any other car of the same size.

This is a matter of current fact and every-day record

Franklin Air-Cooling *cools.* It utilizes an *ever-fresh cooling medium* The harder the engine works, the greater the volume of cooling air that is drawn over the cylinders

Whether the car is standing still, moving slowly in low gear or going on high speed, the *turbine fan flywheel* is at all times drawing in *sufficient air to cool the motor* It does not depend on the forward rush of the car

Franklin Cars are in service in the *coldest* and *hottest* regions on the earth's surface—in Alaska, South Africa and the Indian Empire

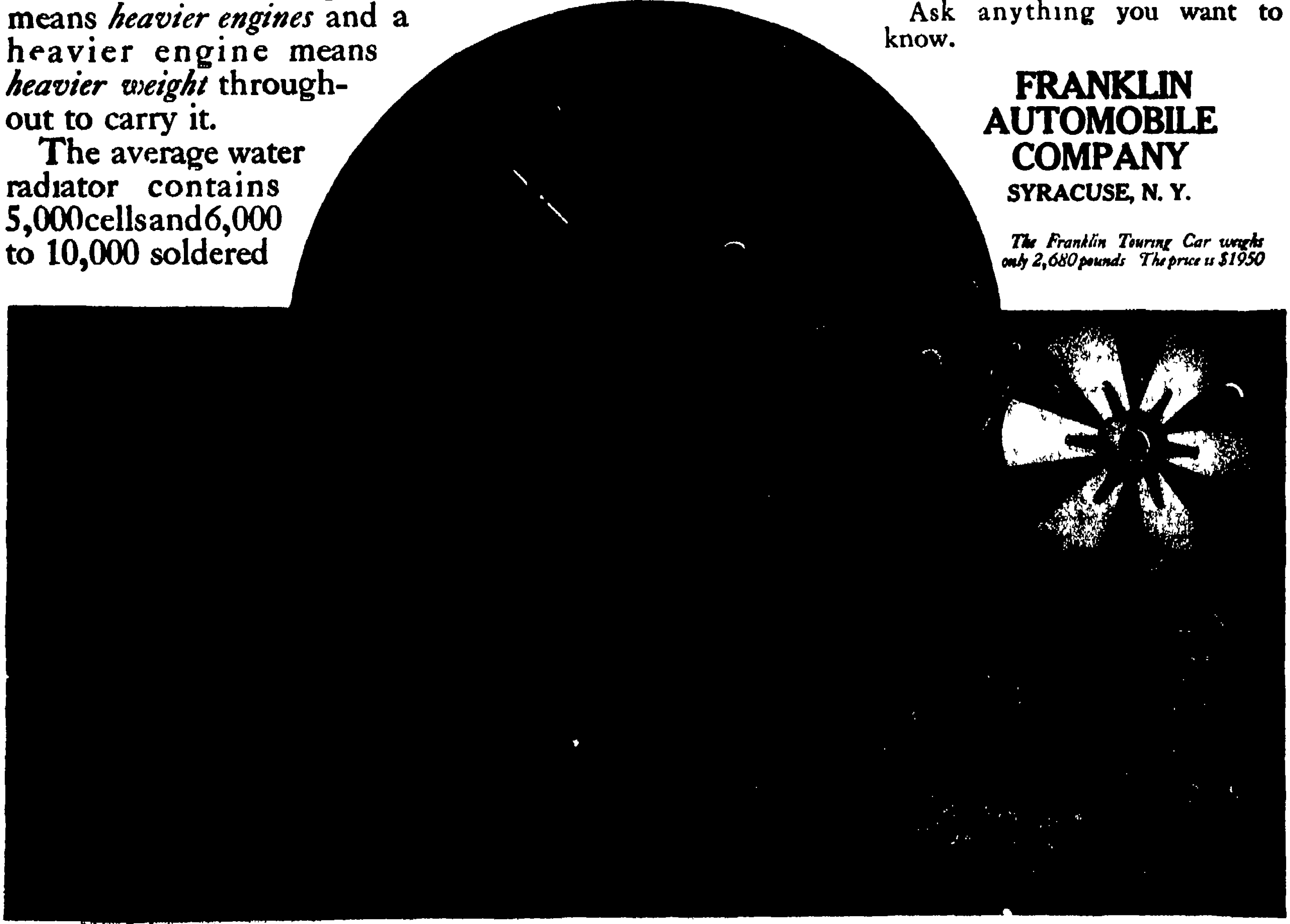
They are in daily use in *every city* in this country and delivering to their users *more comfort* and *more economy* than any other cars they ever owned.

Get acquainted with the Franklin owners and the Franklin dealer in your section.

Ask anything you want to know.

FRANKLIN AUTOMOBILE COMPANY
SYRACUSE, N. Y.

The Franklin Touring Car weighs only 2,680 pounds The price is $1950



These are the 177 water-cooling parts eliminated by Franklin Direct-Air-Cooling The Franklin System of Direct-Air-Cooling *does away* at once with all boiling, all freezing, all leaks, stoppages and failures to cool—*all cooling troubles of every kind* due to whatever cause. It *does away with the dead weight* of radiator, [illegible] pipe connections and water, and with the excessive weight of frame to carry these parts. It gives the *Franklin owner more useful power* for [illegible] than any other car of the same size. It makes possible the Franklin *scientific light-weight*, flexibility and balance, which give the Franklin [illegible] of comfort—about the one car which anyone can drive all day without undue fatigue.

The War Game.—I

(Concluded from page 278)

yards away, watching Jim's movements. This situation will enlighten us in regard to a very important element that of distance. Tom had to cover those few separating yards before he could reach his enemy and, in their case, as in modern war, this action had a significance, for the approaching of the enemy is one of the most important questions. Of course Tom knew all about Jim he knew that Jim was a husky lad not easy to handle, therefore, to improve his own chances, he took that broom stick which stood handy in a corner

In war times such information as Tom had is not so easy to get. The distance from the enemy is problematical, and to gain a definite knowledge of its whereabouts is dangerous and difficult, yet absolutely necessary Timely information regarding the dispositions of the enemy and the topographical features of the scene of operations are essential factors toward the success of any war This is our reason for selecting a strategical reconnaissance for the first war game This is also the natural order of things first, we are out for the information, but while gaining it, we approach the enemy The strategic reconnaissance develops into a tactical reconnaissance and this in due time, is followed by the advance to the battle the attack and the defense

A Strategic Reconnaissance of Four Cavalry Patrols to Establish the Strength and Disposition of the Enemy

In carrying out a strategic reconnaissance two means are at the commander's disposal the dispatching of independent cavalry troops for this purpose and the use of air craft

The aeroplane will through its swift ness, often solve a problem in a few hours which, if cavalry alone were used, might take days. Nevertheless, the influence of weather and other conditions make it imperative to rely more on the cavalry than on air craft Therefore, in this article, we shall handle the action of an independent cavalry reconnoiter

The aim of reconnaissance is to get all the information about the enemy that is available, and to deliver this information safely and quickly to the commander Above all, it must be understood that this expedition is not a fighting expedition, but, if fighting is the best means of accomplishing the assigned task then fight it must be and a successful fight, at that.

The commander of the independent cavalry will receive strict instructions concerning his mission, always with perfect freedom of action. He must then dispatch such patrols as he considers necessary The number and strength of these patrols will vary with the circumstances of each case. The best strength for a patrol is ten to twelve men, larger units would find it difficult to escape observation

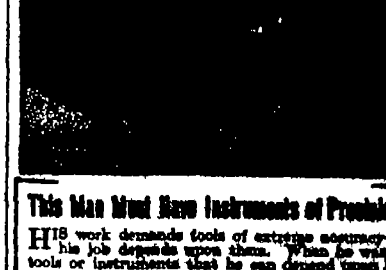
This understood, we shall proceed to the first task in the war games.

Situation

Captain C, commander of a squadron of hussars, independent cavalry, has reached Norrisville, at 6 30 in the morning to undertake a strategical reconnaissance north of Nehaminy River While at rest there, he receives information from a scout aeroplane that small patrols of the enemy have been seen north of Lookout Hill This being important news, he decides to send out four reconnoitering patrols at once For this purpose he selects Lieutenant L, Sergeants S and SS, and Corporal C These four men he leads to the northern edge of Norrisville, from where a good view can be had toward the north and, after a short study of the country and his general staff map (see perspective and map) he gives them the following order

"The enemy is approaching from the north. Small patrols have been observed 10 miles behind Lookout Hill Our main forces are 25 miles south. To gain information regarding these patrols and the following enemy forces, I am going to send out four patrols.

First Patrol.—Sergeant S, on the road



passing Ferguson's farm and across forest to ferry and coal mines

Second Patrol.—Corporal C on next parallel road leading to railroad forking and over railway bridge up north, following Timcum Creek

Third Patrol—Lieutenant L, main road Pottstown and thence up Lookout Hill

Fourth Patrol—Sergeant S8 next parallel road to the west and straight north

Communication to be maintained by each patrol from right to left Reports to be sent in until 12 to Norrisville or main road after 12 o'clock, Pottstown Each patrol shall consist of 12 hussars Urgent duty, patrols leaves at 7 30 sharp

Consideration

The plan of terrain is on a scale of 1 inch to a mile The mounted troops cover the ground at a walk 117 yards, at a trot 285 yards, and at a gallop 410 yards per minute With the trot and walk, judiciously alternated, they average five miles an hour Urgent duty means more than five miles therefore a gallop at intervals will bring it to six miles per hour To measure distances, a compass is very handy but a slip of paper marked with five to six inches will answer With the paper curves can be easily followed

Communication among the patrols means the way of keeping in touch with each other The maintenance of the same from right to left means that patrol No 1 will keep in touch with patrol No 2, and No 2 with No 3, etc Considering that the patrols will be on certain points over two miles apart this can be only accomplished by sending men in between High points from where these connecting links can see and signal to their patrols must be utilized One road might be shorter than the other, therefore the communication service will influence the speed of the patrols They must advance as a screen, hanging together The patrols, for their own safety must protect themselves against surprise. Therefore the commander will send ahead one or two men and in covered country, men will also protect the flanks. In this case, except with Patrols 1 and 4, the side protection is automatic

All this thoroughly considered, we shall proceed to the first question concerning the war game

Developments and Questions

1. When Lieutenant L reaches the railroad crossing at Pottstown, where will the other patrols be and what will be the hour?

(To solve this question, one has to measure the distance of Lieutenant L's road to the point, then this distance must be measured on the routes of the other patrols Now, it will be evident that the routes of Patrol 2 and Patrol 3 are far shorter than those of 1 and 4 Which of course, means an adjustment of the march tempo to enable these patrols to move forward in communication Approximately Patrols 2 and 3 shall cover about four miles in the hour, to the six of the others)

2 By the use of stickpins, mark the situation on the map, then find the positions where the connecting men should be at the moment Lieutenant L reaches the bridge

3 Which patrol will have the most difficult task to maintain the communications? (Consider here mainly the difficulties of the terrain and vegetation)

4. Where will Lieutenant L pass the river?

5 What is the distance from the crossing to Lookout Peak?

Here the elevation must be considered and, since the plan is designed looking straight down, the road is much longer than it appears on the plan

6. How will Corporal C act during the passing from the bridge to the northern edge of the forest? (Consider here that the passage of this forest is dangerous and chances for a surprise are great. To maintain communications, is for the time being, almost impossible.)

7 When Lieutenant L reaches the top of Lookout Peak, how will he proceed? (Consideration must be given to the fact

that this hill is the dominating point. It is, except on the eastern slope, barren, therefore if the enemy is near an undue exposure might hinder the pursuance of the duty of this reconnaissance)

8. Lieutenant L, on reaching the pinnacle of the hill beholds an enemy patrol at the corner of the forest, almost touching the railroad dam, opposite to a house on the hillside What will he do?

(Remember that the main consideration and duty of the patrols is to get information and not to fight)

9 Which direction will the lieutenant follow to escape observation by the enemy? (Consider terrain situations.)

10 Trace with your pins the positions of the four patrols at this moment.

11 What route will Lieutenant L follow to pass on unobserved to reach a point behind this enemy patrol?

12 Will he send a report to his captain?

The solution of these questions will be logically solved, from a military standpoint, in the issue of March 25th

The Result of the Reconnaissance

At 4 P M, in Pottstown Captain C receives the personal report from Sergeant S that on the plateau directly north of the coal mines an enemy battalion with one battery, two platoons of cavalry is encamped, with an outpost on Hill 59 another at coal ferry This latter was put out of action by Patrol 1

No news has been received from Patrol 2

Patrol 3 reports by an orderly, that the enemy has ambuscaded Patrol 2 and, except for two men, all have fallen or been taken prisoners These two survivors reached Patrol 3, which is in touch with superior enemy patrols

News comes from Patrol 4 that it has reached Greenville, no enemy observed, though rifle shots were heard in the east.

At the same time, the 27th infantry regiment, with one battery has reached Norrisville

The next game will deal with the protection service of this detachment near the enemy, and the tactical reconnaissance of independent cavalry in force.

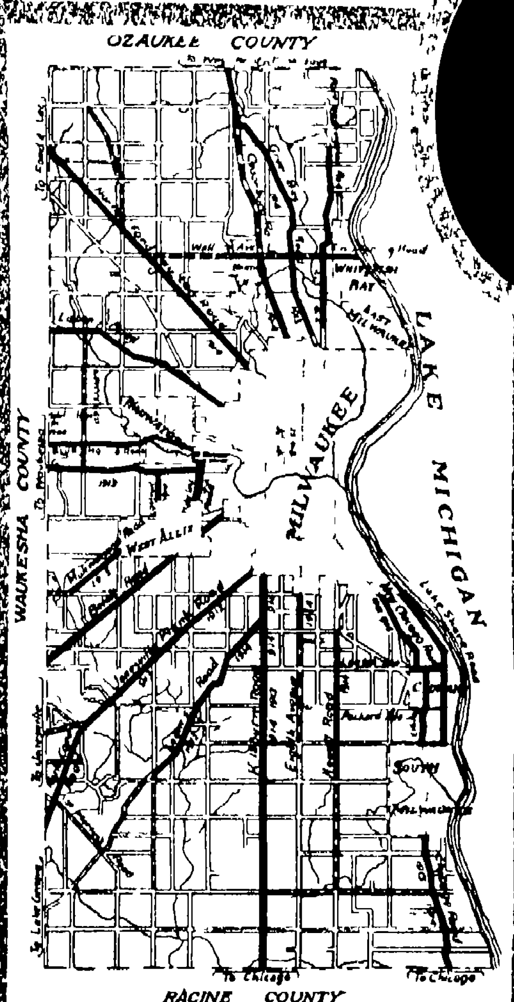
Notes for Inventors

Economical Home Heating —The manipulating of a furnace varies with the point of view It may be regarded as a pleasant exercise and, if the imagination is strong enough be robbed of many of its terrors, or it may be regarded a part of the business of life and be accordingly dignified, but in considering the economical side of the proposition it has been interesting to note after a perusal of a very useful Bureau of Mines bulletin entitled "Saving Fuel in Heating a House," that no suggestions are made as to modifying or improving the apparatus either to simplify or to render more effectual the valuable suggestions as to firing and otherwise controlling the heating fires. There appears to be here a field for invention for those skilled in the furnace art in the production of mechanical features, which will aid in carrying out the useful suggestions, as to manipulating the fires, found in the scientific and at the same time highly practical bulletin But apart from such suggestion the bulletin "Mechanical Paper 97" contains much that will be educational to the fairly expert as well as to the beginner in furnace management.

Makes Baton Sound a Note.—Peter A. Fair, of Helena, Montana, has secured patent No 1160850 in which a baton is provided with a tuning fork at one end which can be sounded by the operation of the baton.

Death of a Safety Razor Inventor—Frederick A. Kampfe, well known as an inventor in the safety razor art, died recently in Washington city where he maintained a winter residence. Mr Kampfe was born in Dresden, Germany, in 1851, and early in the modern safety razor activity entered the field and has since been well known in the industry.

Map of Milwaukee County Wisconsin showing Concrete Roads. Heavy lines indicate finished roads; dotted lines work under construction during 1916



H J Kuelling County Highway Commissioner of Milwaukee County Wis

A Stretch of the Blue Mound Concrete Road Milwaukee County Wisconsin

86 Miles of Concrete Roads

in Milwaukee County, Milwaukee, Wisconsin

HERE are a few facts about the concrete roads of Milwaukee County, Wisconsin, that are of national interest. Read them carefully and remember them the next time roads are discussed in your community. Better yet, tear out this page, it's worth keeping.

Concrete roads are hard, permanent roads constructed of sand and hard crushed stone or pebbles cemented permanently together with Portland Cement into an even, solid wear-proof surface Unlike other "improved" roads in which the broken stone is merely pressed together, the concrete road hardens with age into a monolithic mass which is unaffected by the summer heat or the spring flood and resists the wear of traffic Cement-bound roads will not 'run' in hot weather, automobiles will not lick up and remove the binder Cement is a permanent binder and is an integral part of the road

In four years there have been built in Milwaukee County over 86 miles of concrete roads These roads have been built after the most exhaustive investigation, and in preference to any other type of road In 1915, out of approximately 42 miles of new roads over 39 miles were built of concrete

Milwaukee County has much in common with every community—its roads extend from the city far out into the country, they receive every kind of traffic, wagons, automobiles, motorcycles, carriages, and heavy city trucks The concrete roads of Milwaukee County have increased property values, reduced hauling costs, and reduced road taxes for repairs and maintenance They give satisfactory service every season of the year, in every kind of weather They are unaffected by the hardest travel, free from holes and ruts, dustless in Summer, dry and mudless in the Spring, open all Winter Why not build of concrete in your County?

In New York State, the cost of the 16-foot concrete roads, based on 200 miles laid under all conditions in 1914 and 1915, averaged $9,500 00 per mile for all concrete work and surfacing Including drainage, grading, etc, the total cost varies from $12,000 00 to $15,000 00 per mile Ordinary macadam roads cost about $9 000 00 per mile, but macadam is not a permanent road It will soon rut and wear, the binder will wash out, or be sucked out by passing vehicles, running the maintenance cost into large figures

The concrete road is inexpensive to maintain The figures from the 1915 report of the County Highway Commissioner of Milwaukee County show an average repair and maintenance cost of but $58 00 per mile per year Out of this small sum approximately $23 00 per mile has been expended for the maintenance of road shoulders, etc, ***leaving the actual road maintenance cost but $35.00 per mile.***

When concrete roads are properly laid this low maintenance cost is not unusual but customary The combined maintenance and repair costs on improved roads, other than concrete, of Massachusetts, Rhode Island, Connecticut New Jersey and New York for eight years averaged $608 00 per mile per year

When roads are built in your community build of concrete and you will have roads that are permanent, satisfactory, inexpensive to maintain, roads that will increase values, reduce the cost of hauling and serve you every day in the year

Read what H J Kuelling, County Highway Commissioner, of Milwaukee County, Wisconsin, said

"Our idea of concrete roads, generally, for country road construction, is shown by the fact that out of approximately forty-two miles of road to be built in 1915, we will build about thirty-nine miles of concrete As shown by our report, the increase in traffic is very marked, and without a doubt there is also a very marked increase in property values and general prosperity along the roads"

If there is anything you want to know about the cost and maintenance, hauling statistics, repairs etc, of the Milwaukee County Concrete Roads write to Mr Kuelling personally at his office in the Perckes Building, Milwaukee, Wisconsin

CONCRETE
FOR PERMANENCE

Our well illustrated and informative booklet "Portland Cement Concrete Highways" will be sent free of charge on request, and we invite correspondence relative to concrete road construction and maintenance

PORTLAND CEMENT ASSOCIATION
111 West Washington Street, Chicago

Southwestern Life Building Dallas Texas

116 New Montgomery St San Francisco

Commerce Building Kansas City

SCIENTIFIC AMERICAN

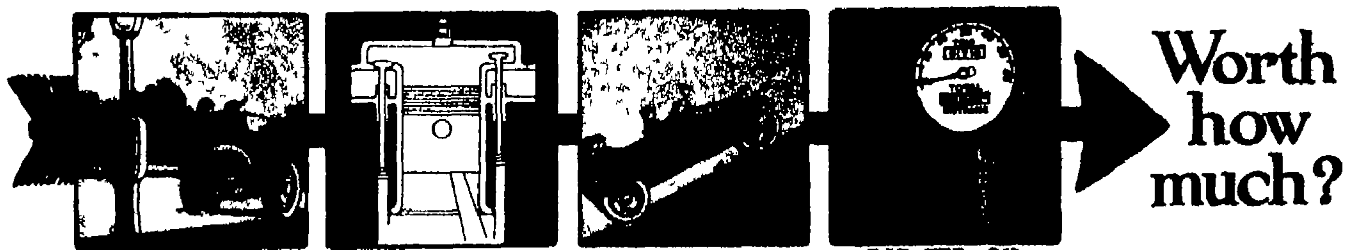
LAUNCHING A SEA PLANE FROM THE AFTER DECK OF THE U S ARMORED CRUISER NORTH CAROLINA —[See Page 295]

March 18, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

Motor Efficiency



CASOLINE ECONOMY | REDUCED CARBON DEPOSIT | INCREASED POWER | GREATER OIL MILEAGE

Motor efficiency depends largely upon lubricating efficiency and that means:

Reduced carbon deposit.

More mileage from your gasoline.

More mileage from your lubricating oil.

Increased power.

There is only one way to experience for yourself the benefits from a really scientific lubricant. That is—*use it.*

A simple test should convince you.

The Lubricating Chart at the right which represents our professional advice, has, for a number of years been the standard guide to scientific automobile lubrication Opposite your car you will find specified the correct oil for your motor.

That oil was specified for your motor after a careful scientific analysis of its lubricating requirements by the Vacuum Oil Company

If your car is not listed, a copy of our complete Lubricating Chart will be sent on request

An Economical Demonstration

It will probably cost you less than $1 00 to fill your crank-case with the grade of Gargoyle Mobiloils specified for your car.

The garage or dealer you trade with has it, or can promptly secure it for you.

Ask him to empty your crank-case of its present oil and fill it with the correct grade of Gargoyle Mobiloils.

You can then judge for yourself the results in—increased power, reduced carbon deposit, gasoline economy, reduced oil consumption.

Is it not worth this nominal expenditure for you to discover for yourself these continuous benefits from using the oil specified for your car by a company whose unquestioned standing in engineering circles is world-wide?

GARGOYLE

Mobiloils

A grade for each type of motor

In buying Gargoyle Mobiloils from your dealer it is safest to purchase in original packages Look for the red Gargoyle on the container For information, kindly address any inquiry to our nearest office

VACUUM OIL COMPANY, - Rochester, N. Y., U. S. A.

Specialists in the manufacture of high-grade lubricants for every class of machinery Obtainable everywhere in the world.

Domestic Branches: Detroit New York Philadelphia Minneapolis Boston Chicago Indianapolis Pittsburgh Kansas City

Correct Automobile Lubrication

Explanation:—The four grades of Gargoyle Mobiloils, for gasoline motor lubrication, purified to remove free carbon, are

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

In the Chart below, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used For example, "A" means Gargoyle Mobiloil "A." "Arc" means Gargoyle Mobiloil "Arctic," etc. The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

MODEL OF	1916		1915		1914		1913		1912	
CARS										
Abbott Detroit	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (8 cyl)	A	A	A	A						
Apperson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A								
Auburn (4 cyl)	A	Arc	A	Arc	A	A	A	A	A	A
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc				
Autocar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Avery	A	A	A	A	A	A	A	A	A	A
" (Mod. 5&C 1 Ton)	Arc	Arc	Arc	Arc	Arc	Arc				
Briscoe	A	Arc	A	Arc	A	Arc				
" (8 cyl)	A	A								
Buick	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Cadillac					Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	Arc	Arc						
Cartercar			Arc	Arc	Arc	Arc	A	E	A	E
" Com'l							A	Arc	A	Arc
Case	A	A	A	Arc	A	Arc	A	Arc	A	Arc
Chalmers	Arc	Arc	Arc	Arc	A	A	Arc	Arc	Arc	Arc
" (Model 6-40)	A	Arc								
" (Model 6-30)	A	A								
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc				
Chase (air)	B	B	B	B	B	B	B	B	B	B
" (water)	Arc	Arc	Arc	Arc	Arc	Arc				
Chevrolet	Arc	Arc	Arc	Arc	A	Arc	A	A		
Cole	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A						
Cunningham			Arc	Arc	Arc	Arc	A	A	A	A
Delaunay-Belleville			B	A	B	A	B	A	B	A
Detroiter	Arc	Arc	A	Arc	A	A	A	Arc	A	Arc
" (8 cyl)			Arc	Arc						
Dodge	A	Arc	E	E						
Empire			Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Federal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Fiat	B	A	B	A	B	A	B	A	A	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	Arc	A	Arc
Grant	A	Arc	Arc	Arc	Arc	Arc				
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl)	A	A								
Hudson	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" Super Six	A	A								
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
I. H. C. (air)			B	A	B	A	B	A		
" (water 2 cycle)	A	A	A	A	A	A	A	A		
" (water 4 cycle)	A	Arc								
Interstate			A	Arc	A	Arc	A	Arc	A	Arc
Jackson	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (8 cyl)	A	A								
Jeffery	A	Arc	A	Arc	A	A				
" (Chesterfield)	A	Arc	A	Arc						
" Com'l	A	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kelly Springfield	A	A	A	A	A	A	Arc	Arc	Arc	Arc
King			A	Arc	A	A	A	E	A	E
" (8 cyl)	A	A	Arc	Arc						
" Com'l	Arc	Arc	Arc	Arc	Arc	Arc				
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" " Com'l	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
" " (Model 48)	A	A	A	A	A	A				
Kline Kar	Arc	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Knox	B	A	B	A	B	A	B	A	B	A
" (Model 38)	A	A	A	A						
Locomobile	E	E	E	E	E	E	Arc	Arc	Arc	Arc
Lozier	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Marion	A	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
Marmon	A	A	A	Arc	A	Arc	A	Arc	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer			A	Arc	A	Arc	A	Arc	A	Arc
" [illegible]			Arc	Arc						
" [illegible]	A	A								
[illegible]	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl)	A	A								
Moline							A	Arc	A	Arc
" Knight	A	A	A	A	A	A				
Moon (4 cyl)			Arc	Arc	A	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc				
National	A	Arc	A	Arc	A	A	A	A	A	A
" (12 cyl)	A	A								
Oakland	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (8 cyl)	A	A								
Oldsmobile	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (8 cyl)	A	A								
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard			A	Arc	A	Arc	Arc	Arc	Arc	Arc
" (12 cyl)	A	A								
" Com'l	A	A	A	A						
Paige			A	Arc	A	A	A	E	A	E
" [illegible]	Arc	Arc	Arc	Arc						
" [illegible]	A	Arc	A	Arc						
Pathfinder	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc		
" (12 cyl)	A	A								
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A								
Pierce Arrow	A	A	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Pullman	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Electric Vehicles—For motor bearings and enclosed chains use Gargoyle Mobiloil "A" the year around. For open chains and differentials use Gargoyle Mobiloil "C" the year around. Exception—For winter lubrication of [illegible] cars use Gargoyle Mobiloil "Arctic" for worm drive and Gargoyle Mobiloil "A" for bevel gear drive.

SEVENTY-SECOND YEAR

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Widening the Range of the Fleet's Eyes By Means of the Aeroplane Catapult

By Robert G. Skerrett

EVEN the layman knows to-day that aircraft have materially altered the problems of military strategy He knows that they have done this by reason of their ability to speed about aloft and to watch with measurable safety the movements of a foe and the distribution and kinds of forces at his command. In short, the aeroplane has permitted spying from high in the air

Just what has thus been done for armies in the field will, in the near future, be done for battle fleets or squadrons. The naval air pilot will become an invaluable aid to an admiral in planning how best to meet his foe or how, if that be the wiser course to avoid an engagement with the enemy's fighting ships All of this may sound trite, but such is not the fact among men familiar with the limitations imposed upon naval aviation until of late.

The seaplane as a naval scout should be able to operate from a moving ship as a base, and to do this with much the same indifference to the state of the weather as its fellow in the military service, starting aloft from the ground. Otherwise its nautical usefulness would in no way be comparable with that so splendidly discharged by aircraft in the army The stumbling block has been very largely the seaplane's inability to get a start from rough waters. The sturdiest of them are able to land upon something of a troubled sea, but their pontoons do not permit them to gain sufficient speed under those circumstances to insure the take-off for a flight. Therefore, even though they might be put overboard safely in the lee of a ship it has not been possible, except under the most favorable conditions of the water, to get them away in flight.

But this difficulty has been surmounted here, thanks to the initial work of Captain Washington I Chambers, U S N, who gave us the idea of a catapult launching apparatus for naval aircraft. As a practical naval man, this officer realised that no fighting ship could afford to be encumbered with long launching platforms such as were tried first here and then experimented with abroad. He knew that space must be economized and the sweep of guns uninterrupted. Therefore he conceived a short run catapulting railway that could be quickly erected and just as rapidly dismantled and stored away. His first apparatus was tested over three years ago at the Washington Navy Yard, and as an outcome of those promising experiments a new machine was designed and sent to the Aeronautic Station, Pensacola, Florida.

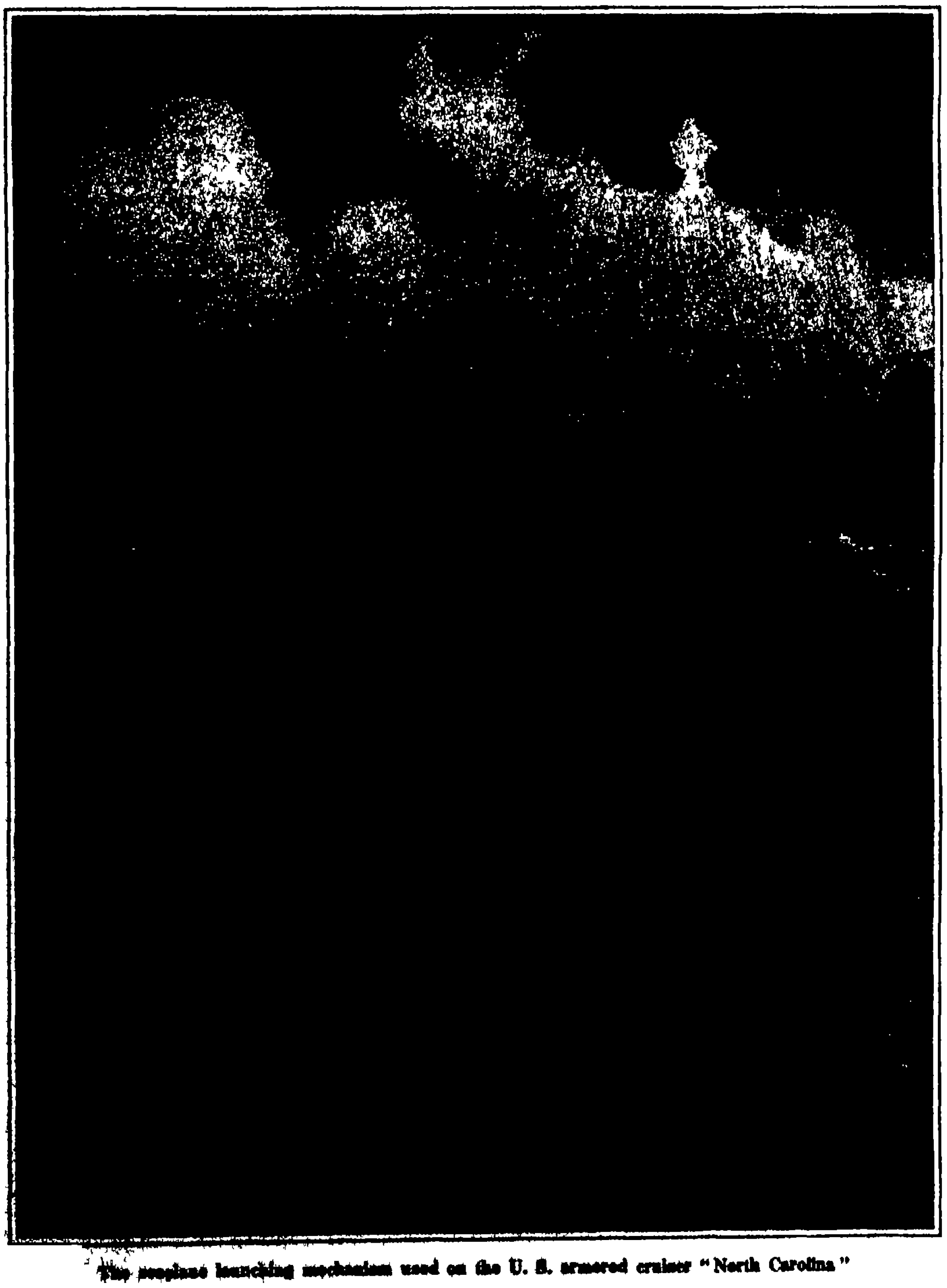
There it was installed at the start upon a coal barge and thoroughly tried out. As a result of its success the apparatus was removed and placed permanently aboard the U S S "North Carolina" It is from this ship that seaplanes have repeatedly been launched in the past few weeks in the open sea and with the armored cruiser underway Despite the fact that one of the older and heaviest of the service aeroplanes has been used in these trials, still the catapult has answered admirably and has taken care of the load imposed upon it again and again This point is suggestive, because the weight factor may be taken to represent either a long range scout or a lighter seaplane equipped with bomb-dropping apparatus

In principle, the launching device consists fundamentally of a car propelled along a narrow gage track Upon this car rests the seaplane, and the aircraft is secured to the vehicle until the latter reaches the end of the runway When the car stops the seaplane is automatically released, and the acquired inertia suffices to sustain the flying machine until its propellers are able to provide the necessary propulsive effort As a rule, however, the aircraft's motors will be speeded up to this point by the time the end of the track is reached The method of operating is as follows The plane is lifted onto the car and secured to it, then the motors are set going but not at full speed. This is accelerated after the catapulting begins The aviator takes his seat in his craft and when everything is in readiness the car, with its load is drawn along the track at an increasing rate This gathering momentum is so nicely controlled that a velocity of about 50 miles an hour is attained by the time the aeroplane is cast loose from the car The car is brought to a standstill a very few seconds later

Originally, the truck was sent overboard at the end of its run, but in service aboard a ship underway at sea this would be undesirable, because it would be necessary either to stop or slacken speed in order to haul the car aboard even if it were held by a line Clearly it would be impracticable to abandon the truck and to hold in reserve any number of them The motive power employed for moving and speeding up the catapult car is compressed air By means of a throttle worked by a cam the air impulse is progressively increased upon the operative piston or plunger which functions the wire rope purchase by which the truck is pulled during its comparatively short run of something less than 50 feet The actual stroke of the piston is in the neighborhood of one inch for each foot of advance on the part of the truck, the turns of the wire rope over pulleys serving to produce this multiplication of movement The air required by the catapult is supplied from the torpedo air service of the cruiser and at a pressure of something like 300 pounds per square inch

The runway is made up of light steel angle iron and raised only three feet or so above the ship's deck to which the structure is secured by attachments that can be quickly released when it is desired to dismount the apparatus The aviator is not jarred during the acceleration of the car and the final catapulting of the seaplane The only sensation on the part of the pilot is like that due to a sudden blast of air in the face The trials so far have been conducted with the "North Carolina" steaming along at cruising speed

A scout cruiser is capable of covering a visual front of but 20 miles under favorable conditions of the atmosphere An air scout 4 000 feet aloft can observe ships 70 miles away! There is no need of elaborating upon the strategic advantage obtained by the use of scouting seaplanes It is just this widened field of observation which the aeroplane catapult makes possible



The seaplane launching mechanism used on the U. S. armored cruiser "North Carolina"

A Study of Fog At Sea

ACCORDING to the last annual report of the U S Bureau of Standards, a preliminary investigation of the properties of fog at sea formed part of the programme of work carried out on the last ice patrol of the Coast Guard cutter "Seneca" A study was made of the number of condensation nuclei in the sea air, and also of the amount of liquid in the fog particles

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Merit in Place of Politics

ABSOLUTELY the most important institution embraced under the comprehensive term "naval defenses" is the Naval Academy at Annapolis. To this institution are sent the young men of America who (presumably because of their inherent fitness for the task) have been selected to control the country's outermost defenses, its far flung line of battle on the high seas. So enormous is the responsibility which rests upon the shoulders of a naval officer that the average American citizen would naturally suppose that each contingent of young men, as it is selected year by year and sent to Annapolis, is chosen solely on the ground of its physical, mental and moral fitness for the arduous duties and high national responsibilities of a naval officer. This would imply, of course, selection by a system of searching, competitive examination.

As a matter of fact, with a few exceptions, no such system of selection exists. On the contrary, the success of the candidates is dependent, in the majority of cases, upon the political exigencies with which our senators and representatives find themselves confronted when they make their annual selection of young men for Annapolis and West Point, for it is a lamentable fact that, more often than not, the selection of the candidates for the enormously important duties of the naval and military officer is entirely in the hands of the professional politician.

Nor does the influence of politics end with the appointment of the cadet, nor even with his failure. "The powerful political hand," says the Conference Committee on National Preparedness, "that puts a young man into either Academy (Annapolis or West Point) may often be raised to keep him there after he has been tried and found wanting. At times a twenty-five cent telegram may set all the machinery of a vast political organization into motion to save a failure from dismissal."

Now, such conditions are nothing less than scandalous. The Congressman who recommends a young man to the Academy on any other grounds than his fitness therefor is guilty of an act that is highly unpatriotic. We will go further and say that the Congressman who will set in motion political enginery to save a discredited youth from dismissal is guilty of that which, in the spirit if not in the letter, is perilously near to high treason.

Some of our Congressmen, it is true, are fully alive to the need for competitive examinations and the young men of their districts enter Annapolis and West Point only through that straight and narrow door, but the practice should be made obligatory and universal. In his annual report for 1913 Colonel C. P. Townsley of West Point says: "These cadetships belong to the people of the District, State, Territory, etc., and should be open competitively to all the youths eligible to compete, and it is my recommendation that a law be enacted requiring competitive examinations to be held for each vacancy, that youth to be appointed who passes successfully the best mental examination, and who is physically and morally qualified. The examination questions should be prepared by the Academic Board, and a successful passing of the competitive examination should qualify a youth to enter so that no other mental examination need be required. The details of conducting such examinations should, I think, be left to the Secretary of War. By announcing in the local papers some ten months or a year in advance that such a competitive examination will be held, stating its scope, it is believed that there will be a large number of eligible youths who will present themselves for examination in each district from which a vacancy is to be filled."

We commend this matter, as being one of the most vital affecting national preparedness, to the thoughtful consideration of every congressional district throughout the country. At once and absolutely, the matter of the selection of young men for the high duties of the naval and military officer should be lifted out of the dubious field of politics.

War and the Nitrogen Supply

HAD Germany not made provision for obtaining nitrogen from the air before the outbreak of the war, it is probable that her resistance would have collapsed many months ago for lack of powder and high explosives. With that far sightedness which is one of the most conspicuous elements of her efficiency, she set her chemists to work, long ago, searching for some artificial means for supplying nitrogen, which would render the country independent of the Chilean deposits, hitherto the great source of supply. Germany has recently announced that she is today independent of outside sources, and that she can keep her powder factories going indefinitely in spite of the British blockade.

One of the most important investigations undertaken by the Naval Consulting Board is that directed to the question of a supply of nitrogen for the naval and military needs of the United States. The Chairman of the Committee of Physics and Chemistry has presented a report embodying the result of a joint investigation by itself and the Committee on Ordnance and Explosives, and has sent the Navy Department a resolution to the effect that the synthetic production of nitrogen products is immediately vital to the agricultural and military interests of the United States. The Secretary of the Navy is requested to urge upon the President that he coördinate the efforts to make effective the synthetic production of nitrogen in this country by the creation of a committee which shall include representatives of the Departments of Agriculture and the Interior and the Army and Navy Departments, to study the question and report on the same at the earliest possible moment.

In all the present discussions on preparedness it is certain that there are some things which can be done, or at least started, immediately; among these, and perhaps most important of them all, is this question of making the country independent of the Chilean nitrate deposits. It is no exaggeration to say that upon the quick solution of this problem may depend the fate of the nation.

Arctic Controversies

IN another column of this issue we publish a letter from Mr. Edwin Swift Balch, a writer whose views on polar questions always command respectful attention. From time to time in the past we have commented on Mr. Balch's efforts to reverse the judgment of the world regarding Dr. Cook. His arguments are an eloquent presentation of the conservative attitude that although Cook's claims have never been verified, they have never been disproved, coupled with suggestions as to ways in which future exploration may either, on the one hand, give greater plausibility to them, or on the other, effectually discredit them. Cook has had other respectable champions, and some of them have not been so conservative in their championship as Mr. Balch. There are, for example, certain German geographers of good standing who to this day habitually speak of the conquest of the pole "by Cook and Peary." Cook has had some staunch supporters in congress.

The Cook-Peary controversy has, however, been a particularly distasteful chapter in the history of American science, and this journal would be loth to do anything toward perpetuating it. There are probably very few geographers who doubt that Peary reached the pole. Attempts have been made to minimize the value of the scientific work carried out by his expedition, but it should be remembered that a journey of hundreds of miles over a frozen ocean in quest of a definite goal, during the brief season when daylight and the state of the ice make such a journey possible, is necessarily a hasty affair, and affords little opportunity for elaborate scientific observations. Such data as Peary obtained were frankly and promptly submitted to competent authorities on his return to civilization, and the record of his journey bears the earmarks of being a straightforward narrative.

On the contrary, Cook's extraordinary gyrations, from the time he arrived in Copenhagen minus his records down to his recent press-agent methods of arousing public sympathy in his behalf, inspire neither respect nor confidence. Even while reserving judgment as to the possibility that he got to the pole, one is inclined to hope that he did not.

It so happens that the speech by Representative Helgesen to which Mr. Balch refers has no direct bearing upon the polar controversy, and does not even mention Dr. Cook. Mr. Helgesen's remarks are primarily a criticism of the geographical work done by Peary on several of his expeditions, and of the U. S. Hydrographic Office for incorporating in its charts data some of which were questionable while others had been definitely proven erroneous. Mr. Helgesen's long speech is an interesting scientific document, and one that we should like to see reproduced in a geographical journal. He raises several questions the ventilation of which would be much more profitable than a revival of the question "Who discovered the north pole?"

The last paragraph of Mr. Balch's letter calls attention to an interesting exploit that appears to have been overlooked by the geographical journals and the newspapers.

A Heat Standard for Gas

THE recent decision of the Public Service Commission for the First District of the State of New York, to substitute a heating value standard for illuminating and fuel gas in place of the present candle power standard, is in line with modern developments in gas technology and will aid in securing a better basis for regulation, fair to both consumer and manufacturer. With the widespread use of gas for cooking, heating, and power in various domestic and industrial applications, its heat value is, of course, an important element, while with the increased and all but universal employment of the incandescent mantle burner, the illuminating power of the gas itself has become subordinate to its heating power.

Of course, in the early days of the manufacture of illuminating gas, when open burners were used exclusively, and when the gas stove or range was hardly thought of, it was necessary to demand that the gas furnished possess a specified candle power and that it should be so made or enriched with oil rich in hydrocarbons as to burn with a flame brilliant enough to afford the desired degree of illumination. As this enrichment of the gas involved considerable expense to the gas company, it was of course necessary to maintain by legal standard the quality of the supply. This was particularly the case in connection with water gas, where by passing steam over a bed of incandescent coal or coke the hydrogen is separated from the oxygen which combines with the carbon of the coal to furnish CO, both of these gases being combustible but not affording a luminous flame until mixed with a gas made from petroleum oil. With coal gas produced by the distillation of coal in a retort, there is less need of the enrichment, but even here this gas often needs to be brought to a proper standard of illuminating power for use with open burners. The introduction of the incandescent mantle in gas lighting has wrought many changes in the gas industry and has become general. Open flame burners, relatively, are so few that now it is hardly necessary for the luminous quality of the gas to be considered, though there are certain uses for which the open flame burner is well adapted. If a candle power standard is maintained it may result that the gas can be so enriched that it will not give the best service with mantles, not to mention its fuel functions, while if the gas is too poor it is, of course, undesirable for open flames.

In this connection it is interesting to note that when the gas pressure exceeds a certain limit there is not a corresponding increase of candle power in the naked flame burner. But the householder who uses gas for heating purposes (by which we mean to include the heating of gas mantles), will receive light from his burner and heat from his range in proportion to the readings of his gas meter, regardless of fluctuations of pressure.

The United States Bureau of Standards for several years has given considerable attention to the matter of standards for gas service, and it has reached the conclusion that there is no question that the heating value standard is superior to candle power regulation. The Bureau recommends that a heating value standard be maintained with, however, a minimum standard of candle power, say 12 to 15 candles, as a secondary standard for the benefit of the minority of open burner users. This, of course, would present no hardship, as most gases as made by the ordinary processes now in use would comply with such a nominal candle power regulation. The proposed change in New York it is believed will make for better service, as gas of high heating value can be made more efficiently and be distributed with smaller losses in heating value, and with less effects from abnormal weather conditions. This should give better and more economical service to the consumer, for gases of nearly normal heat value but very low candle power are now available, and these can be supplied at a reasonable price if the illuminating value of the gas may be neglected.

Instead of the photometer, with which daily tests of the gas of New York city are made to determine whether when burning at a burner which consumes five cubic feet an hour, the legal standard of 22 candle power is realized, the Public Service Commission now proposes to have a number of testing stations where calorimeters will be installed and the gas tested for its heat value measured in terms of British heat units. In American gas practice the average heating value runs about 620 B.T.U. per cubic foot, and the average candle power about 19.5. The usual heating value required by the various state and city regulations is 600 B.T.U., and an increasing number of commissions, both state and city, are now making their requirements on this more practical basis.

Naval and Military Notes

Terrific German Howitzer Fire.—Never in the history of artillery has there been witnessed such a concentration of heavy shell-fire as was rained down upon the French positions during the recent attacks on Verdun. A French officer speaks of the great rapidity of the gunfire, likening it in this respect to that of the French direct fire artillery It is probable that the bulk of the work has been done by the highly mobile and very effective Krupp howitzer of 8 2-inch calibre

American Naval Gunnery—Testifying before a congressional committee, Admiral Fletcher gave it as his opinion that from 10 to 20 per cent of the shots fired from an American battleship would land on an enemy at 18,000 yards, this estimate being based on the recent target practice at Guantanamo He stated that his flagship, the "Wyoming," in target work at 12,000 yards had put three 12-inch shells through a 10-inch armor plate.

The Fulfilment of Russia's Dream?—Among the dramatic surprises of the war, of which there have been not a few, the swift capture of Erzerum and the equally swift descent of the Russian troops into Asiatic Turkey must always be conspicuous The campaign in the Caucasus, hitherto regarded as insignificant, may yet prove to be the means by which Russia will realize her age-long dream of a port on the warm seas, open the year round for her incoming and outgoing sea borne trade

Preparedness in 1891—There was brought into this office the other day a blue-print of an American type box car designed and built by an American firm to the order of the German government for use on the State railways. Although they were built twenty five years ago, provision was made for placing a line of railway station benches, back to back, down the center of each car, and folding benches were shown down each side and across the end of the car Thus Germany in 1891 prepared for the swift mobilization of 1914

Trials of Our Latest Dreadnought—The "Pennsylvania," our first ship to carry twelve 14-inch guns, recently went through her high speed trials satisfactorily, averaging for some hours one half a knot above her contract speed of 21 knots. In gun power, and particularly in armor, the "Pennsylvania" may be considered to outmatch the latest dreadnoughts of other powers, but her speed, having in mind what the other people are doing, is lamentably low, in proof of which consider the 25-knot British "Queen Elizabeth," the 28-knot Russian "Gongort," and the 22.5-knot Italian "Caio Duilio."

To Shoot Across the Channel.—A dispatch from Berlin credits Professor Rausenberger with the statement that artillery will be built of such great size that it will be able to bombard England across the Channel, but it would not be necessary to increase the size of the gun to secure the necessary range of 21 miles. There are existing guns—plenty of them—that can cover far greater distances than that. Many years ago Colonel Ingalls, in calculating the ballistics of the Brown 10-inch wire-wound gun of 4,000 foot seconds velocity, found that at 45 degrees elevation the shell would be thrown a distance of 49 miles and that, during its flight, it would rise 18 miles into the air

British Navy 1,000,000 Tons Larger—The First Lord of the Admiralty, Balfour, states that the tonnage of the British navy has been increased by 1,000,000 tons since the outbreak of the war If so, we cannot understand into what kind of ships this great displacement has gone The 14 dreadnoughts which have been added would not account for one half of that total, and what the other half is made up of it is difficult to imagine, although there has been a great increase in the number of light cruisers, destroyers and submarines. It will probably be found that the new monitor fleet is larger than was supposed, furthermore, in all likelihood the 1,000,000 tons covers the auxiliary ships taken over by the government

Frontal Attack in the Present War—In the years preceding the war we were told that so murderous would be the combined artillery, machine-gun and rifle fire from an entrenched position that no troops in the world would attempt a frontal attack. The war has proved the very contrary Indeed, the present gigantic struggle for the capture of Verdun has consisted, so far as the German infantry is concerned, of little else but frontal attacks against what are probably the most completely defended positions in the world. It is probable that since the early history of warfare troops have never been subjected to such a frightful ordeal as the dense masses of German infantry which have stormed, or attempted to storm, the outlying Verdun positions. The High Command of the German army knows what it is about, but the average layman is beginning to ask himself how long the German army can last if its numbers are to be reduced through the coming spring and summer at the rate of wastage in the Verdun battle.

Science

Farmers' Bulletins issued by the U S Department of Agriculture during the last fiscal year numbered 14 795,000 copies, which was slightly less than the number issued in 1914, but far greater than in any previous year The number of new bulletins of this series issued in 1915 was 77, a much greater number than in any previous year In addition, 243 old bulletins were reprinted

The Hessian Fly Outbreak of last spring was one of the severest on record according to the U S Bureau of Entomology Starting in northern Oklahoma and Kansas, the infestation swept over the wheat belt northward and eastward, doing most of its damage, however, west of the Mississippi and north of the Ohio and Potomac Rivers Several publications were issued during the year warning farmers of the impending outbreak and giving them advice relative to the management of their fields in such a way as to reduce the damage Of a single circular nearly 200,000 copies were distributed

Measuring the Turbidity of Spinal Fluids—The far reaching ramifications of the work carried out at the Bureau of Standards is illustrated by the fact that the bureau has been recently, at the request of the Psychiatric Institute of the State Hospitals of New York, making a study of the turbidimeter to determine its usefulness in measuring the turbidity of spinal fluids, with a view to aiding the diagnosis of mental diseases. The applicability of the turbidimeter to this purpose was demonstrated and a representative of the bureau was thereupon designated to aid the institute in designing an improved form of the apparatus especially suitable for the work in question.

The Problem of Caring for Lepers in the United States is one that arouses interest whenever a fresh case of leprosy is discovered elsewhere than in the few states that maintain special homes for these unfortunates As a result of an inquiry conducted by the Public Health Service in 1913 no less than 148 cases of the disease were definitely located in this country The bulk of the patients were native born Lepers tend to be migratory, because by changing their place of residence they can often escape for a time the isolation and ostracism due to the prevalent dread of the disease Thus the movements of these persons constitute an interstate sanitary problem At the last session of Congress a bill was introduced providing for the national care of lepers. Although this bill passed the House of Representatives, it was not acted upon by the Senate prior to adjournment.

National Quarantine System—In his last annual report the surgeon general of the U S Public Health Service calls attention to the fact that there is no federal quarantine service at the ports of New York and Baltimore, and urges that this anomaly be corrected In the year 1893 Congress gave sanction to the national control of quarantine by providing that whenever the proper authorities of a state should be willing to turn over its quarantine stations to the national government, the latter should have power to accept them. Under this authority, between the years 1893 and 1915 the quarantine function at 67 different places was transferred from state to national control The transfer was made at Boston during the last fiscal year One reason why a uniform national quarantine is desirable is the fact that the United States is a party to two international sanitary treaties, under which international quarantine regulations have been formulated, and the federal authorities should be in a position to carry out directly their obligations under these treaties

The Botanical Status of the Rain Tree.—A recent memoir of E D Merrill, of the Philippine Bureau of Science, deals with the systematic position of this splendid shade tree, which has been so widely planted in tropical countries and which is the subject of an oft repeated legend, according to which it sheds water from its leaves and branches in such abundance that its use for irrigating arid wastes has been seriously recommended! This fantastic notion has been refuted many times. (See Scientific American, September 16th, 1911, p. 244.) Mr. Merrill says that he "has never observed, in this species, any dripping of water from hydathodes, such as has been noted in some tropical trees" Moreover, he suggests that the common English name, rain tree, and its Spanish equivalent *arbol de la lluvia*, probably owe their origin to the fact that the "sleep," or closing of the leaflets, is a very conspicuous phenomenon at the approach of and during rains, as well as at night In the Philippines, where it is by far the commonest shade tree found in the larger towns, the rain tree is commonly known as "acacia" In Hawaii it is called "monkey pod." Reverting to the question of its botanical affinities, Mr Merrill adds to its already extensive synonymy by erecting to generic rank Bentham's section *Samanea*, in which the rain tree becomes *Samanea Saman*.

Aeronautics

Aviation School in China—Vice Consul P B. Josselyn, at Canton China has been informed that the Chinese government is about to open an aviation school at Canton, for which it will need several machines

American Record for Hydroaeroplane—What is declared to be a record endurance flight for hydroaeroplanes was established by Corporal Smith attached to the U S Signal Corps Aviation School at North Island Cal, when he recently remained in the air 8 hours and 42 minutes

Aeroplanes for Manila—It is reported that there will soon be shipped from the Government aviation station at San Diego, Cal, four of the new army hydroaeroplanes which will form part of the equipment of the Second Aero Squadron at Manila These machines are said to be the largest in the service, and can fly for about 500 miles without alighting for fuel

Effectiveness of Aeroplane Raid—The seventeen French aeroplanes which made a raid on Petriz in the Strumnitza Valley, on February 1 remained over the Bulgarian town for twenty minutes and dropped 200 bombs. According to a Bulgarian *communique*, 470 men were killed in the Bulgarian camps, and the total of killed and wounded was about a thousand In spite of a heavy fire from the enemy all the aeroplanes returned safely to their base

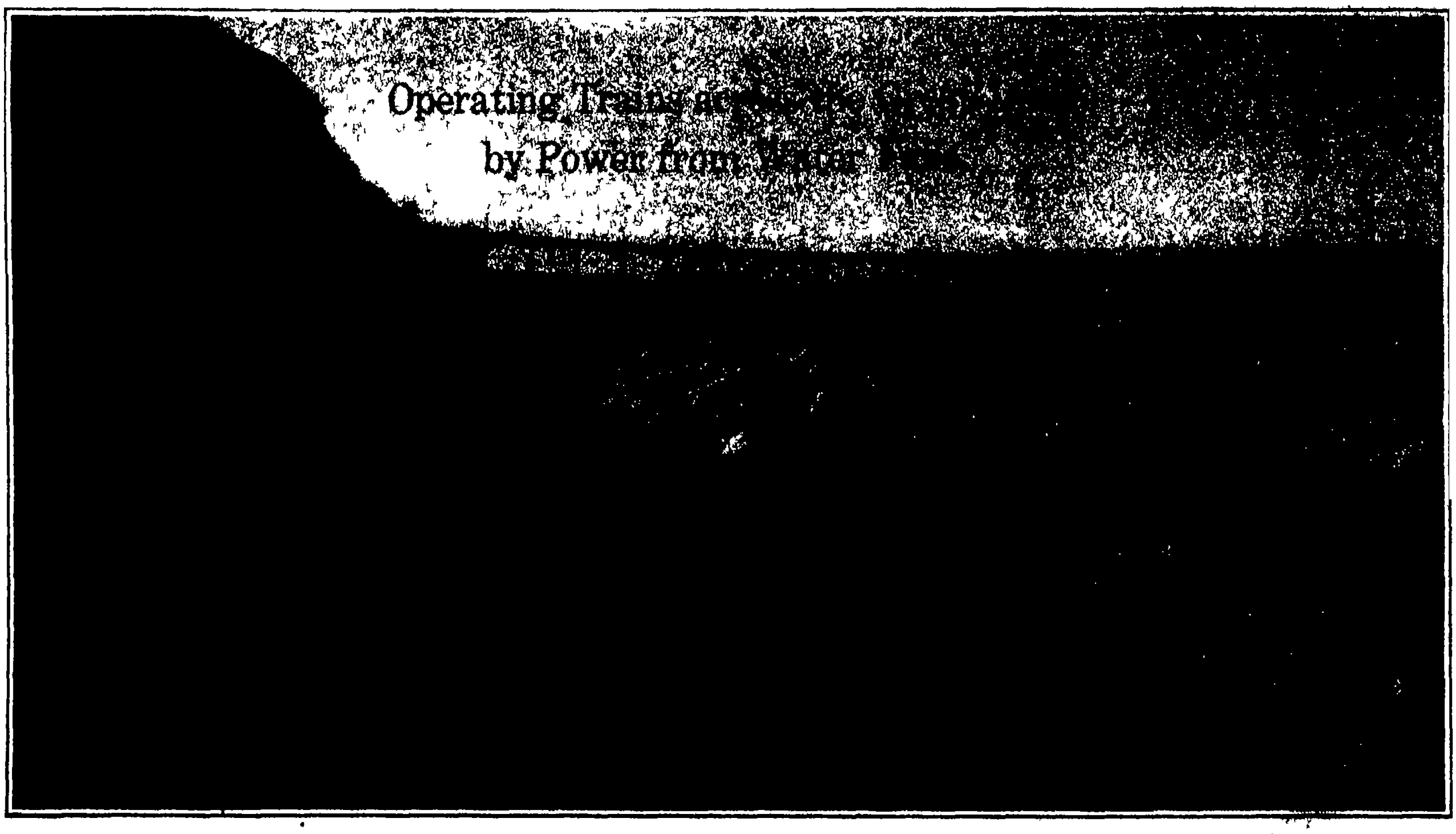
Kite Balloon for United States Navy—An American airship constructor has lately exhibited a model of the first and only kite balloon ever constructed for the United States Government, which is now being completed for the Navy The actual balloon will be 175 feet long 50 feet high and 35 feet in diameter and is of the type used by the German army Thousands of such balloons are being used in Europe both on land and on water, and have proved of immeasurable value in directing gun fire

Government Building a Large Seaplane—*The Aerial Age Weekly* states that it has knowledge of a dispatch from Washington which, on the authority of a high official discloses the fact that there is under construction at the Washington Navy Yard a seaplane that will in the expectations of the Government officials, be superior as a fighting unit to anything that is now flying The Government undertook the manufacture of the seaplane because the manufacturers here were so busily engaged with rush orders for foreign governments. No details regarding the new machine are available at the present time

Bombs in Zeppelin Raid on Paris—According to information secured from an authentic source it is learned that during the recent Zeppelin raid on Paris forty bombs were dropped by the aircraft part of them incendiary and the remainder explosive Since a number of the bombs failed to explode the authorities have been given an opportunity of examining their construction These ordinary steel spheres without handles two of them weigh 136 pounds and measure 12½ inches in diameter The shell is 5/16 inch thick and contains 46 pounds of trinitrotoluene The third bomb weighs 224 pounds and measures 20 inches in diameter

Advantages of Multi-Planes—"The eliminating processes of the present war have made the monoplane almost extinct for two reasons since the speed range need not be sacrificed," states Neil MacCoull, M.E., writing for the *Aerial Age Weekly* "These reasons are the greater inherent structural advantages provided by the girder like construction of the biplane, and the compactness resulting from the smaller spread required for a given area of wings—a matter of importance in landing in restricted places and in storage and shipment Both of these reasons must be considered when the spread of the lower wing is made less than the upper, though the advantage of a short lower wing when listing to one side while making a landing should not be overlooked

Insurance Against Aircraft Damage—It is reported by the United States consul stationed at Dresden that a leading insurance concern in Germany has established a department of aerial insurance The company is issuing policies covering damage to all property, real or movable, caused by explosive bodies or other objects thrown or falling from flying machines or caused by airships or aeroplanes themselves in making voluntary or involuntary landings or parts thereof falling from them The policies, however, make no provisions for injury to or loss of life It is said that the numerous air raids over German cities and towns near the battle-fronts particularly in the West, have caused a demand for such policies



Tremendous volume of water at Rainbow Falls, the power of which in the form of electricity operates trains over mountain ranges

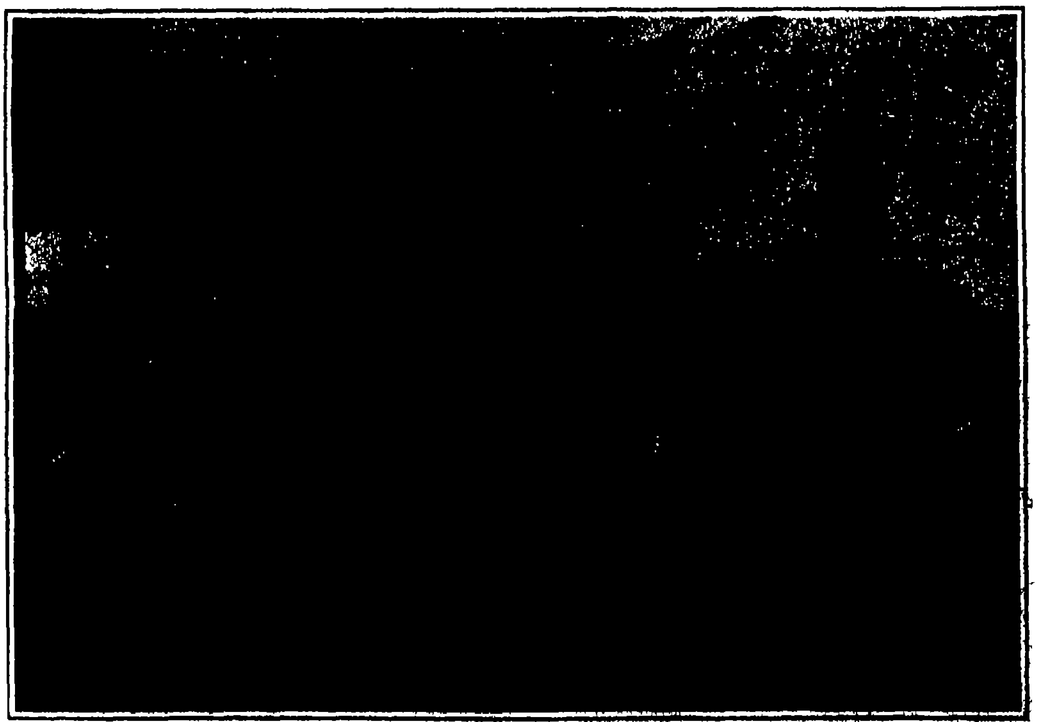
SLOWLY but persistently electricity is replacing steam on the leading rail roads of America, and it therefore comes as no surprise that a steam railroad crossing the Great Continental Divide should adopt this efficient form of motive power, especially in view of the fact that the district served by the line is replete with rivers and waterfalls that are available to hydro-electric development.

For 440 miles, or from Harlowton, Montana, to Avery, Idaho, over the Big Belt, Rocky, and Bitter Root Mountain Ranges, which form the Continental Divide, the main line of the Chicago, Milwaukee & St. Paul Railway has been electrified Two hundred and thirty miles, from Harlowton to Deer Lodge, is now in actual operation The cost of the entire work has been approximately twelve million dollars, and it has required three years' time to complete The electrical energy is obtained from the mountain waterfalls along the route

The electrification of the road is characterized by two remarkable features first electricity is transmitted with minimum loss over considerable distance, second ly, by producing the electrical energy from mountain waterfalls in place of coal a definite step is taken towards the conservation of the world's resources.

From Harlowton to Avery the electrified section of the road crosses the Big Belt Mountains where at Summit an altitude of 5,788 feet is reached the main Rockies or the Continental Divide an altitude of 6,322 feet at Donald; the Bitter Root Mountains, an altitude of 4,200 at East Portal Pipestone Tunnel, the half mile bore through the backbone of the continent at Donald, is the highest elevation of the railway

Electric power house at Rainbow Falls, which supplies the current for operating the trains over the Great Continental Divide



Interior view of one of the sub-stations which step down the high tension alternating current and transform it into 3,000 volt direct current for use by the locomotives

To give an idea of the difficulties that were confronted in this enormous undertaking, a 2 per cent grade had to be surmounted for a distance of 28.8 miles along the east approach to the Continental Divide, immediately west of the Continental Divide for a distance of 10 4 miles is a 1 66 per cent grade, and on the western slope of the Big Belt Mountains for a distance of 40 miles is a 1 per cent grade —where the track climbs 52 8 feet to the mile. These grades make steam locomotive operation difficult for long, heavily loaded freight trains, and especially so in winter time. To-day electric locomotives not only haul heavier trains more smoothly over these grades, but travel at much greater speed than when steam power was used, in all kinds of weather

The particular and impressive feature of the Chicago, Milwaukee & St. Paul Railway electrification accomplishment is that this is the first undertaking to install and operate electric locomotives on tracks extending over several engine divisions under the most difficult traffic conditions. The various terminal and tunnel electric installations made by railways in the past were more or less necessary by reason of local conditions and limited to short distances. Purely economic reasons, together with anticipated superior operating results and greater comfort for the traveling public, was the inspiration for the extended electrification of this railroad; and it is not unlikely that the results obtained, will

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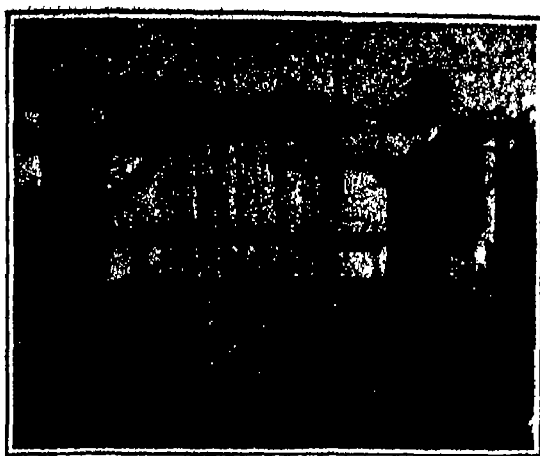
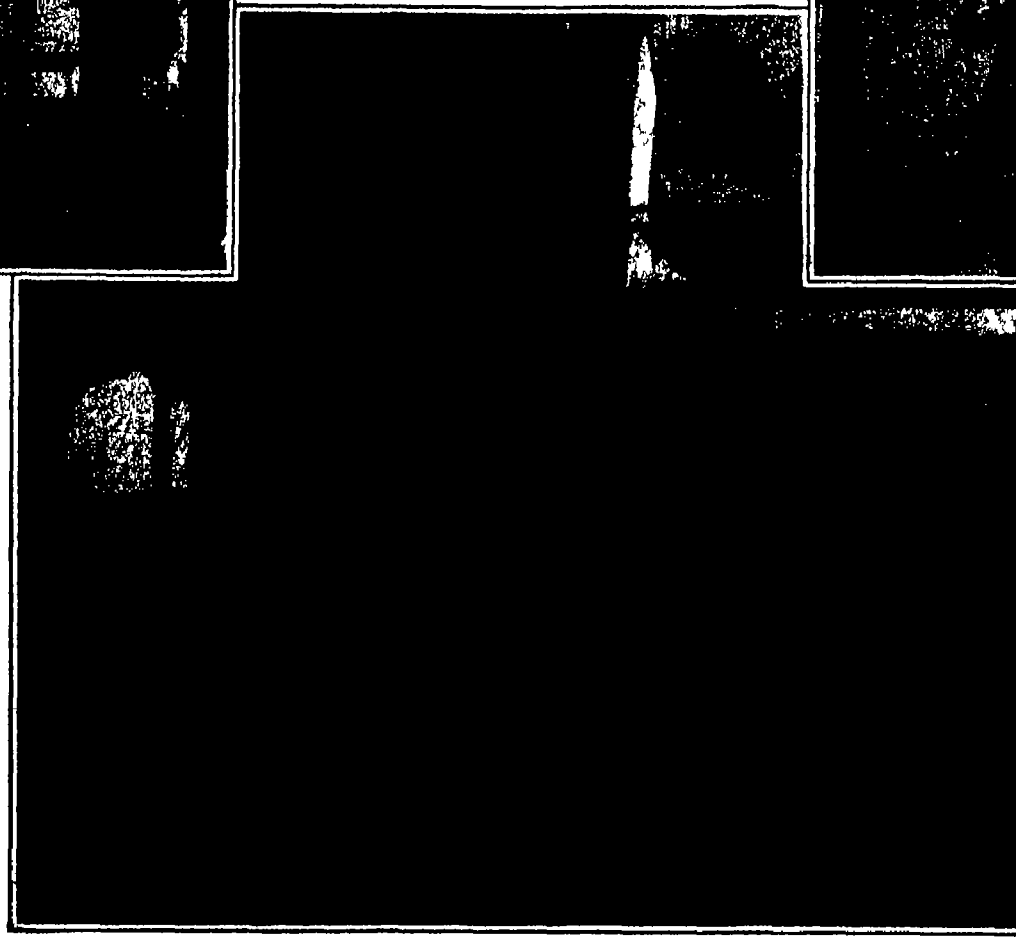
Million-Volt Commercial Frequency Transformer

By L R Perry

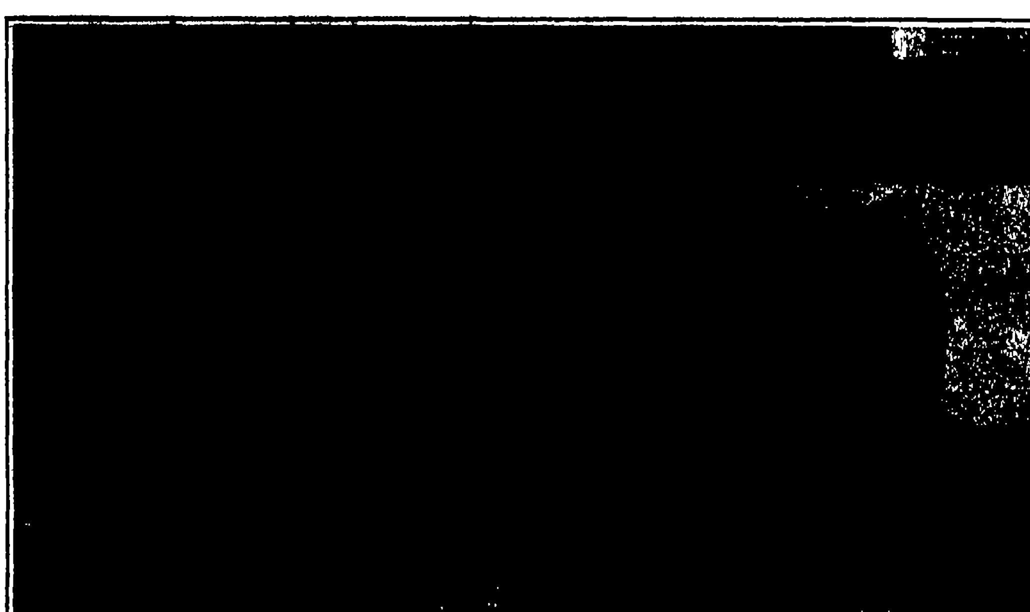


Prof Larkin and spectator drawing 3-inch sparks from insulated disk placed under screen



Primary coil in place on laminated iron core, with the paper insulating tube about to be slipped over it. This view shows the concrete metal-lined tank to advantage

Wire basket corona insulator for confining high potential current and protecting rope insulators



At the left: Four-foot secondary of the million-volt transformer. At the right 2,000-pound paper insulating tube interposed between the primary and secondary windings

THE remarkable million volt sixty-cycle transformer which was erected at the Panama Pacific International Exposition and used for a number of experiments and demonstrations during the closing week of that exposition, was described at length in the SCIENTIFIC AMERICAN, Vol CXIV, No 3, page 77 However, at the time it was not possible to present illustrations of the installation, but since then photographs have been secured and are presented in the accompanying views. Also, a number of additional facts, pertaining more particularly to the experiments, have been obtained and are embodied in the paragraphs that follow

It will be recalled that the million volt transformer attracted the attention of the leading electrical engineers because of the fact that it operated on a 60-cycle, 2,200-volt primary current, in contradistinction to other high tension transformers or Tesla coils built in the past to operate on high frequencies. This transformer was rated at 1,300 horse-power and built by C H. Thordarson of Chicago, Ill

Many months of tedious preparation and toil were spent before the final moment of the trial came. The inventor spent over $30,000 in accomplishing the construction of the transformer according to his new theories, and the San Francisco Exposition spent an added $6,000 in setting up the device for operation and demonstration in suitable quarters, this being no less than a moderate sized Zeppelin" hangar and an acre of ground space adjoining the Palace of Machinery On this spot the coil was brought into successful operation from the start. Many noted engineers and scientists beheld its action and its numerous phenomena and electrostatic effects, and last but not least, thousands of spectators did likewise scores at a time walking through and feeling the presence of an electrostatic field 50 feet square and 30 feet thick energized by the coil at a point 100 feet distant. Many remarkable effects and experiments were indulged in by the crowds, this being the first time in history that such an opportunity had been offered on so large a scale

It had been surmised by the inventor that a new and unexplored field of research would be opened up by the existence of such an electrostatic field, and it is said that the results have been highly gratifying Probably one of the greatest discoveries thus far has been that power can at last be generated, safeguarded and transmitted on a scale never before attempted For years leading manufacturers of America and Europe have endeavored to construct high potential transformers to operate on low frequency—60 cycles or lower, and failures have been innumerable until the success of the Thordarson transformer Furthermore, it is now apparent that this type of transformer is destined to work radical changes in the scientific and industrial worlds large or small

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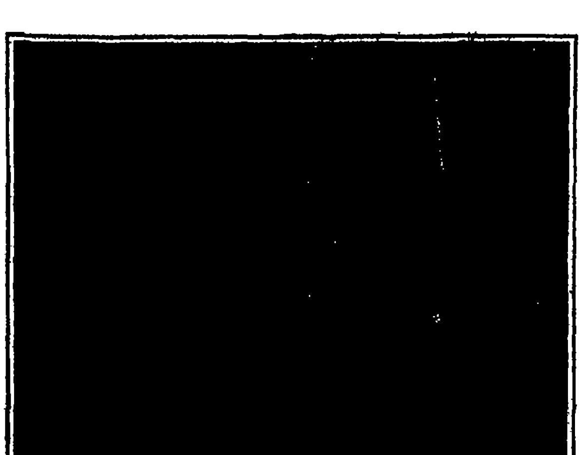
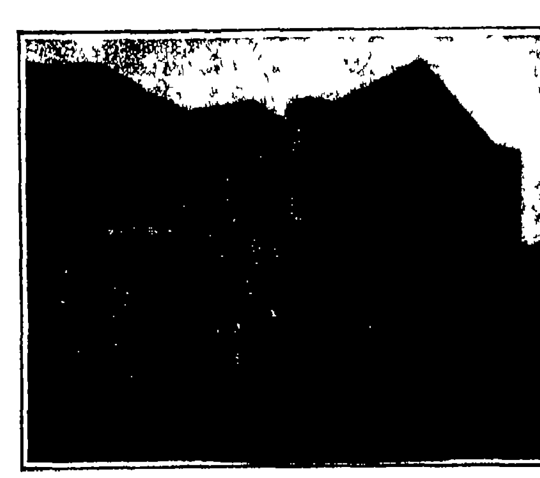


Night crowd enjoying public demonstrations and opportunity to experiment

A section of the transformer secondary as compared to secondary of 20 k.w. transformer



Special building erected to house the huge transformer used in the tests

Industrial Preparedness for Peace

V. The Human Side of Salesmanship

By Miner Chipman

THE first World's Salesmanship Congress will be held in the city of Detroit in July 1916. It is hoped that this great convention fathered by Hugh Chalmers Norval A. Hawkins, John Wanamaker and others will stimulate the entire country to a realization of our trade opportunities Rapid strides are being made in the efficiency of salesmanship We have much to learn in the problem of selling to the consumers of foreign lands. We have the goods we have the men we have the money, all we need is competent guidance and a proper recognition of the human element

Sales Lost Through Lack of Postage

Commerce Report Number 50, for March 1st 1916 has the following item relating to solicitation of business in the island of Jamaica

"A letter received by the Chamber of Commerce of the State of New York from an American business representative in Kingston Jamaica, emphasizes once more the need of correcting serious mistakes that are made by firms in the United States, in communications sent to the island Hundreds of letters soliciting trade in this British community are in the Spanish language while carelessness is shown also in the lack of attention to postal requirements The postage to Jamaica from the United States is five cents, but the writer says 'Letters come invariably with two-cent stamps, making the addressee pay six cents surcharge'

"Complaint is made, also, that American businessmen do not take the time to write a few pleasant things in their letters and thus fail to gain the attention of persons in foreign countries."

With the one exception, the office boy's frequent attendance at the funeral of his grandmother, there is nothing more annoying to a businessman than the payment of "Postage Due" It is a manifest reflection upon the efficiency and foresight of the sender The cause of this inefficiency is found in the delegation of responsibility A firm desires to extend its trade into South America The head of the house delegates the responsibility for trade extension to a sales manager, who in turn delegates the responsibility to an ambitious clerk, who finally delegates the seemingly unimportant matter of postal rates to a $6.00 a week office boy

Standard Practice Instructions

The Larkin Company of Buffalo provides each employee with written Standard Practice Instructions covering the functions and operations for which he or she is responsible Responsibility is delegated, but with staff plans, and staff instructions. You may be assured that the Larkin Company would not mail letters to Jamaica with insufficient postage attached Staff officials in its organization make it their business to see that such errors do not occur A large manufacturer of writing papers has employed a man to do missionary work among the printers of the country He is sent out to obtain first hand knowledge of the use and abuse of fine writing papers, and teach the printer new methods for selling and utilizing the product of the paper maker The operators of the American Telephone and Telegraph Company are given several weeks' instruction in the multitude of "little things" that make for efficiency in telephone service It is not enough to look at things in a *big way* we must look at the little details in a big way for our success or failure will be determined by our control of these seemingly unimportant matters.

Getting First-Hand Knowledge

The businessman who really desires to extend his trade should make staff studies of the field he intends to cover It may be unnecessary for him to go further than the public library If he is wise he will get in touch with the Bureau of Foreign and Domestic Commerce He may correspond with the leading universities many of which maintain specially trained staffs dealing exclusively with these problems. The letter quoted above calls attention to another important matter, viz. the neglect to put a little human touch into a communication Many salesmen imagine that curtness is efficiency Some time ago a salesman covering a large territory in South America said to me "I usually spend two or three months getting acquainted with my prospects I never mention business We meet in a cafe or have dinner together We manage to get very well acquainted Suddenly I get the business. A salesman simply cannot force those fellows down there—a large percentage of the business is done because they like you other things being equal The importance of the human equation in business may be discovered all about us I believe the most valuable asset in an employee is the ability to be effective and calm forceful and courteous. One day last week I had an appointment with Hon Elbert H Gary, Chairman of the Board of the United States Steel Corporation I arrived at the office in the Empire Building to the minute, and was met by a clean-cut healthy looking gentleman, who introduced himself as Secretary to Mr Gary His name is George K Leet, and he's a wonder We visited for about ten minutes He was so courteous so interested in me and my work, that when I left the office I did not realize that I had not met Judge Gary until I stepped out on Broadway I then realized that efficient Mr Leet had casually advised me that the Judge had another pressing engagement and would be obliged if I would cancel my appointment He was a masked battery Hidden under cover of soft green foliage were the machine guns of efficiency I can easily realize why he holds one of the most important and difficult secretarial positions in the country That type of ability never goes begging for employment The world needs just that kind of men The markets of the world are open to salesmen who have the charm and courtesy of a gentleman and the holding power of first line trenches

Service—Giving the Customer What He Wants

Time and time again American manufacturers have been reminded that it is necessary to fit the product to the customer in seeking trade in South America. The Germans know how to do this. The sale may depend upon the design of the wrapper, the size of the container or some other seemingly unimportant detail Unimportant in the eye of the manufacturer, all important in the eye of the customer John Ballentine was the merchant prince of the small town where I spent my boyhood He represented a type of the merchants of the old school John was his own buyer, and what he purchased the people *had to buy* He defined service as selling the people *what he had*. In the pioneer days when wants were few, and style was confined to the cut of a kitchen apron, this type of merchandising would pass without challenge Occasionally an upstart of a customer, who had, perhaps, visited Detroit or Chicago, would ask for something not in stock John would invariably say "Why I do not keep it, I could not sell it if I had it." The inevitable march of time brought a growing demand for style and variety John could not change. He failed and never knew why Men who fail for this reason seldom know why The merchandising problems of the world are all typified in the small town merchant When John Clark started an exclusive grocery store The people laughed. The merchants laughed From the time when a Huron Indian stuck his tomahawk into the pine tree at the crossing of the state roads and called it "Bad Axe," it was considered necessary for a merchant to carry everything in stock from corn starch to red flannel underwear John Clark succeeded. He more than succeeded. He is now the proprietor of a large and prospering wholesale grocery He adopted new and radical policies He not only offered for sale "What the people wanted,' but he educated the people to "wants" they had never known before. He put in fancy lines of groceries, with purple and gold labels, and got fancy prices. It became a matter of social prestige to serve French peas for dinner eat grape-fruit for breakfast. He made merchandising a social institution That is the real secret of trade expansion. The merchant must have a community interest he must not only supply the existing wants, but he must educate his customers to other wants having a profitable significance Fame and fortune are relative terms the name of Altman in New York has the same relative potential value as John Clark in my old home town Both gained their reputations through efficient *service*

Merchandising Policy

In my opinion the store of William Filene's Sons Company in the city of Boston, is the most scientifically operated merchandising organization in the world. Ten years ago some of their advanced notions were scoffed at by merchants throughout the country The policies they established were first laughed at, then studied, then adopted by other stores throughout the country The operation and administration of the Filene store would make a good subject for study by any man desiring to conquer foreign fields of merchandising. Fundamental in the Filene business is *Policy* Nothing is left to guesswork Planning is the beginning of everything is the source of all action, and so well planned that success is usually assured. The Filenes have never closed their doors to suggestion from the outside The development of scientific management in the Midvale Steel Company's plant by Frederick W Taylor was immediately reflected in new methods and new systems in the Filene store. The planning and despatching evolved in the shops of the Santa Fé Railroad under the direction of Mr Harrington Emerson had its effect upon the management of the Filene store They have what is called an Automatic Bargain Basement. It is a novel institution. In this Bargain Basement merchandise is either sold or *given away* If an article is placed on sale at $1.00, it remains at this price for twelve selling days, and if unsold the price automatically drops to 75 cents, at the end of another six days it drops to 50 cents, in another six days to 25 cents, and then if unsold at the expiration of another six days it is *given away* This department is the most high tension, rapid-fire merchandising scheme in the country It involves some of the most important and fundamental principles in modern merchandising The automatic price reduction of the Filene Bargain Basement is thoroughly scientific Few merchants would have the nerve to initiate such a plan, but the Filenes not only have the nerve, but have the ability to make it a tremendously profitable undertaking It is interesting to know that in this Bargain Basement the Filenes do a business equal to half the volume of a number of the large stores on Fifth Avenue The secret of their success lies in their policies, and their exhaustive planning of detail. The name of Filene is synonymous to Planning and Efficiency

Selling Father Through the Baby

One of the most successful insurance salesmen in the country has achieved his position through recognition of the human element in business. His first step is to make friends. He aims to discover their hobby, he endeavors to find the soft spot in their hearts, and then gently, very gently, plays upon it. He sold a $25,000 policy to a friend of mine through a carefully worked out heart throb campaign, the center of which was my friend's nine-months-old baby He first sent a number of clever little poems, linking daddy and baby and life together. He then developed the theme into the deeper meaning of life, its duties and its struggles. He constructed a career for the baby, sent him to school and then to college. It required money Before the youngster had reached the age of ten months the father had insured his life for $25,000 to see the plan through This life insurance salesman knows the power and force of ideals. He plays on these forces. He not only becomes a successful salesman, but leaves behind him a score of friends and a long list of satisfied customers.

I once had the pleasure of meeting a book agent who made $10,000 a year through an appeal to the human equation His scheme was crooked, but it illustrates the force of human appeal. He dressed like a young college lad, and sought out in every town and city the college graduates. He then canvassed them with a plea for assistance to put him through the last year of his college career. It worked By appealing to the Rah! Rah! days of the Alma Mater he sold his wares. He was not selling books, he was selling sentiment.

Expansion of Trade Into Foreign Markets

The secret of merchandising success lies in *Organization*. Not a mechanical organization, but the building of a great human mechanism Brains in the Staff and Brains in the Line—there are no substitutes. Back of the plans, back of the merchandise, we must have real men. *Men* who know and understand other men, *Men* with a touch of sentiment. The mere accumulation of cold facts, the establishing of agencies, the sending of samples, the bidding for trade is insufficient. We must have more than all these. We must have men who can analyze the inner sentiments and aspirations of the foreign peoples, fit their policies to the stranger peoples, and aid them in the attainment of their national and racial ideals.

A study of markets is a study of people. Do not depend upon the first edition of Chambers' Encyclopedia, the Explorations of Humboldt, or Prescott's Conquest of Peru for your information. Get posted—right up to the minute, and do not forget that you are selling men not merchandise

From the Editor's Mail Bag

A. B FARQUHAR, President, A. B. Farquhar Co., Ltd., of York, Pa., Director of the Chamber of Commerce of the United States.

"As the world never was in such a condition before in all its history, it would be impossible to prophesy either when the war will end or the conditions in

(Concluded on page 308)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Present Status of the North Pole Question

To the Editor of the SCIENTIFIC AMERICAN

On January 18th, 1916, the Hon. Henry T Helgesen, of North Dakota, made a speech on the floor of the House of Representatives (published in the *Congressional Record* of same date, pp. 1002-1009), summing up what he has accomplished by much hard work for over a year Briefly the results of his labors are that the Navy Department (Hydrographic Office) and the Coast and Geodetic Survey have been obliged to repudiate and take off from Government charts all of Admiral Peary's reported discoveries, namely "Peary Channel" (thereby denying Peary's claim to the insularity of Greenland), "East Greenland Sea" "Crocker Land" "Jessup Land," and the soundings claimed to have been made by Peary in 1909, when he asserts that he reached the North Pole. This ends finally any controversy about the discovery of the North Pole for Peary's claims are now officially thrown out.

Mr Helgesen does not, however, touch in any wise on the claims of Dr Cook These now stand at present as follows Cook's claims to have made the first ascent of Mount McKinley have been verified unintentionally and unwillingly by the climbers who followed him up the mountain. Cook's discovery of the non-existence of Crocker Land has been verified by MacMillan Cook's three other Arctic discoveries, Bradley Land Cook Land Ice, and the endless fields of purple snows at the North Pole, rest now for proof entirely on Cook's own statements and astronomical observations corroborative geographical evidence can no longer be drawn from Peary's statements since these are now officially declared invalid

The verification or disproof of Cook's discoveries geographically, however, is only a question of time Besides the unknown Arctic, there is almost nothing, except part of Antarctica, left in the world to explore Bradley Land has already appealed to one explorer and the time is perhaps not so far distant when a new expedition will start for its shores Nevertheless, the fact that Peary was deceived by a mirage into believing that there was a land which he called Crocker Land shows that there is a possibility that Cook also was deceived by a mirage into believing that there is a land which he called Bradley Land. And the further consequence of this is that while the refinding of Bradley Land would absolutely verify Cook, the finding that it was non-existent would not of itself discredit him And if it should prove to be non-existent, there would still remain Cook Land Ice in 87 deg -88 deg N, and the endless fields of purple snows beyond 88 deg N, by which to verify Cook's discovery of the North Pole

In saying that Bradley Land has already appealed to one explorer, I must tell briefly of an attempt to reach it which was made in 1914 and 1915 by Messrs. Rudolph Franke and Arthur Haack and which failed partly on account of unusual ice conditions. They sailed from Quebec on July 4th 1914, on the S S *Guide*, with the Canadian Arctic explorer and fur trader, Captain J Bernier, who agreed to leave them at the entrance of Jones Sound. On account of bad ice, they were unable to reach either Etah or Jones Sound After a summer spent in fighting the ice floes of Baffin Bay, they were finally nipped just south of the entrance of Lancaster Sound and forced to winter there While out hunting one day, a great blizzard came on in which Mr Haack was frozen to death. This ended Mr Franke's hopes of trying to reach Bradley Land and he returned to Quebec with Captain Bernier to find himself a prisoner of war, a unique ending to an Arctic voyage of exploration.

Philadelphia, Penn. EDWIN SWIFT BALCH.

[Editorial comment on this letter appears on p. 295.—ED.]

Battery vs. Magneto Ignition

To the Editor of the SCIENTIFIC AMERICAN

In the SCIENTIFIC AMERICAN of Jan. 1st, 1916, on page 11 you refer to "The Trend Toward Battery Current Ignition." The statement you make that "with the universal adoption of electric starting and lighting systems has come a marked diminution in the number of firms using high-tension magneto ignition," requires further explanation, as it does not do justice to the magneto.

While it may be true that the number of makers using battery igniton has increased, it is by no means true that the number of cars so equipped has increased. I call your attention to the fact that out of 176 cars listed in the show issue of *Motor Age* of Dec 30th, 62 of them, or 35 per cent, were magneto equipped By far the largest number of cars are actually magneto equipped. High priced cars are practically all magneto equipped, and nearly all foreign made cars use magneto equipment Battery ignition has practically nothing to recommend it except cheapness It is true that for a while the manufacturers of eight and twelve cylinder engines had difficulty in securing suitable magnetos, but this has *recently been eliminated* Both eight and twelve cylinder magnetos of high efficiency are now procurable and a standard product with one of the largest American manufacturers of magnetos

There are many objections to making the ignition on an automobile *dependent upon the starting and lighting battery* It is seldom that this battery is at its maximum efficiency, not because of anything inherently wrong with the charging outfit provided but usually due to a lack of care on the part of the average user It may be true that the varying conditions of a battery does not affect the ignition this is claimed by some makers of battery ignition, but there is one thing certain that a car with battery ignition will not run when the battery is dead and such cases are only too *frequent* The complication of battery ignition, the timer mechanism often being a part of the lighting and starting dynamo, is well known and while many attempts have been made to remove this complication it still exists to a large extent The many wires and connections sometimes requiring thermostatic switches for cutting off the current in case the ignition switch is left on' with the engine at rest and the fact that these systems are but slightly understood by the average repair man, all tend to make the battery ignition system secondary in efficiency and desirability from a standpoint of the average car user The original high tension magneto was rather complicated and difficult to repair This does not hold good with the modern types wherein the windings are removable, the breaker points stationary, and all parts easily accessible for inspection and repair by anybody The fact that magnetos are used on practically all high grade cars, all aeroplanes, and exclusively for racing should be sufficient evidence that they are considered by those who know to be far superior to battery ignition in any form, the main reason for the use of other forms of equipment is cheapness.

Sumter S C H R VAN DEVENTER.

Pistol vs. Bayonet

To the Editor of the SCIENTIFIC AMERICAN

Mr Crossman's timely and interesting article on the bayonet causes the question to arise whether in many cases, weapons specially adapted to certain conditions weapons which might be transported in motor trucks and served out on occasion to troops trained in their application would not greatly increase the effectiveness of our Army

If bewildering speed was an essential in the invasion of Belgium and France, it would be of still greater importance in a campaign conducted with the objective of conquering a considerable area in the United States It seems unlikely that the initial expeditionary force would include sufficient heavy ordnance for trench blasting operations on an extensive scale, as its disembarkation and transport, together with millions of rounds of ammunition, would occasion serious delay It seems probable that the invading infantry would be pushed forward to the limit of endurance, and then be dashed against our thin defensive line in a terrific drive If this premise be correct what arm in the hands of intrenched defenders, or reserves, will be most effective upon the mass formation of the enemy, when rifles are empty and the time too short to insert another clip?

At this juncture I believe 2,000 riot guns per mile would smother 20,000 bayonets. I once witnessed a test of one of these weapons, a short barrel cylinder bore automatic shot gun, capable of delivering 50 to 60 buck shot in an almost continuous cone of fire It would be a tremendously effective weapon for close combat, and spare magazine cylinders could be devised, for quick loading In the hands of cavalry trained to use it from the saddle it would be far superior to saber or lance in a melee

Now as to the application of another weapon, let us assume that *our forces* are on the offensive, they are within a few feet of bayonet contact with their opponents, they are about to fight with a general purpose weapon—the bayonet—which, as Mr Crossman aptly states, is inferior to the weapons of antiquity, under these conditions, both sides being armed with weapons of equal inefficiency, if an attacker succeeds in "putting out" a defender, he has done about all that may be reasonably expected of him. Furthermore we are credibly informed that among trench labyrinths, entanglements, etc., the bayonet, because of its unwieldiness, is often discarded for the knife or bludgeon, thereby retrograding to caveman efficiency

If the individual infantryman in the attack, carried his rifle slung on his back and was provided with two heavy calibre automatic pistols, and had been trained in their use—a two-handed gun fighter—we might reasonably expect him to place five or six of his opponents hors de combat, as many a frontiersman could have done with his old forty-five Colts.

Katonah, N Y GEORGE HALL.

Trieste

To the Editor of the SCIENTIFIC AMERICAN

As a constant reader of your highly esteemed publication and one who, through long years, has come to value the scientific importance of the articles published in the SCIENTIFIC AMERICAN I have been following with a keen interest the series of letters written by your military expert in connection with the Strategic Moves of the War in Europe

And while all along sincerely appreciating the earnest endeavor on the part of your war correspondent to do full justice to both sides, it was *not* without some regret that in reading through his letter of the 24th November (which has only now come to hand) I came upon a statement made perhaps inadvertently but which, as not being in accordance with the strict historical facts, I see *myself prompted to correct* so as to prevent any misconception on the part of your American readers as to the motives which have led Italy to enlist on the side of the Entente

For if, with reference to the city of Trieste your military expert at the *conclusion of his letter* holds out the hope that "the Italians will bring again under Italian rule their citizens who for years have been looking forward to the day when they should again be living under the flag of King Humbert (sic!)

" he *appears to labor under the impression* as though that portion of the Austrian Empire originally was Italian territory and that all the Italians are now driving at is merely to get back their own Now any such statement made in good earnest would be a *flagrant contortion of historical truth* and I must ask you to allow me to point out that Trieste never did form a portion of the Kingdom of Italy, as a simple reference to any standard encyclopædia will immediately corroborate

Trieste (the Roman "Tergeste") was originally settled by various Latin colonists and from having formed a portion of the vast Roman Empire fell in the course of time under the sway of the Habsburgs, and has continued to constitute an indivisible portion *of the Habsburg Monarchy from the year 1382* onwards to this present hour, with the sole exception of two short intervals namely from 1797 to 1805 and from 1809 to 1814, when it was under *French* rule But it *never was* under Italian predominance and, please God it *never shall be*

Your war correspondent being a military gentleman and therefore not easily daunted, even by facts, I apprehend that he may come forward and tell me that *prior* to 1382 Trieste was held by the Venetians This is, of course, not denied, but to my mind this would as little justify any present claims made by Italy, as if Spain were suddenly to reclaim Florida or the Netherlands, Manhattan Island

It is also true that the majority of the inhabitants of Trieste, as of all the Austrian Coast Land consider the Italian language as their mother tongue this, however, has absolutely no bearing upon the question but merely confirms, what I have already pointed out, that this section of Europe was settled by colonists coming from the opposite shores of the Adriatic and this long before the present Kingdom of Italy was ever dreamt of In fact, if similarity of speech were to decide the point under discussion, then with equal justice France might to-day lay claim to the Province of Quebec and the Kaiser be entitled to call on Uncle Sam to immediately yield up—Milwaukee to the German Empire

I shall be glad if you will give publicity to this letter for the sake of historical truth, and thanking you in anticipation for any courtesy shown I am,

ARTHUR LINDENSTEAD

1 Karlsplatz 3, Vienna, Austria.

Paper as Fuel

To the Editor of the SCIENTIFIC AMERICAN

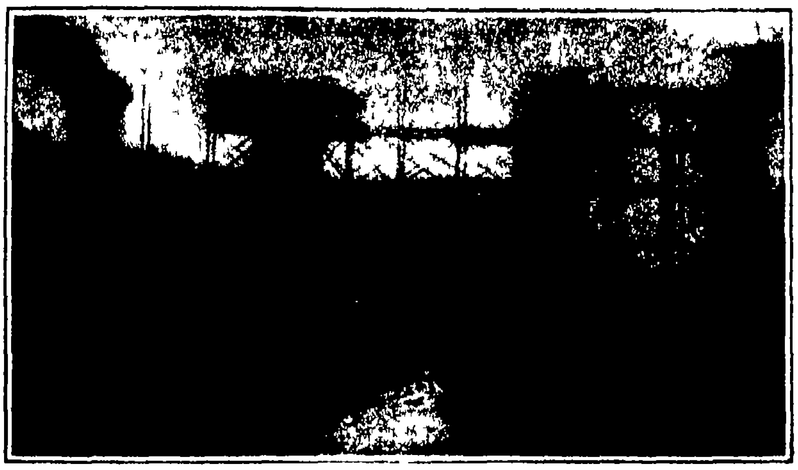
I notice in a paragraph on page 10 of the January 22d issue some news of the paper fuel now used in Italy It is somewhat incorrect and vague To begin with, the rolls of newspapers, after being cut into small cylinders, are boiled for about 10 minutes in a solution of paraffin and naphtha which gives them their burning qualities.

They are only used by soldiers which have been on duty (sentinel, etc) and have not been able to partake of their food with the rest as the food reaches the trenches in a hot state and remains so for quite a while as it is carried in boxes similar to the fireless cookers.

The soldiers do not care for this paper fuel as it makes a very sooty flame and never use it in camp (that is, when they are enjoying their 15-day rest) because they don't need to then. The many committees that sprang up fo the manufacturing of these "Scaldaranei" as they are called, are little by little quitting, having seen the little utility of their work.

CHARLES I WHARTON

8 Teresa a Chiaia 41 Naples, Italy



This bridge 591 feet long and 108 feet high was restored in a very short time

One of the big tasks negotiated by the German railroad organizations

German Military Railroad Organizations at Work

IN order to appreciate what was the nature of the task that suddenly confronted the German railroads at the beginning of August 1914, it is necessary to recall general conditions at the time. The holiday season was at its height and the traffic incident to it was heavy. Great volumes of freight were in movement, besides, and in every military district the big practice grounds were occupied by troops engaged in annual maneuvers. When war was declared on the 2nd of August the citizen population away from home made a general rush to the railways in order to escape delays that might be expected to follow when the tremendous tide of soldiers and equipment set toward the fronts. Thousands of others rushed by the same routes to distant points to reach sons, brothers and husbands at the practice camps before they should be off to the battlefield.

Some of the divisions had to be sent to the western frontier through sections alive with manifold industries. Thousands of long military trains were needed. In order to prevent hopeless congestion while these trains were en route all of the stations along the lines had to be cleared of a staggering number of loaded and empty freight cars. Simultaneously with the advancement of these troops an equally heavy movement in railroad equipment was begun. Hundreds and hundreds of freight cars and coaches and scores and scores of locomotives made up in seemingly endless trains were pushed along to those sections of Germany where according to careful calculation, the rolling stock would be most needed.

Then began the real mobilization. Millions of reservists were carried to their appointed rendezvous, and supplies and accoutrements for the troops were brought up together with the wartime armament for the fortifications nearest the enemy. From those sections of Germany where horse raising is especially followed train load after trainload of these animals were taken to the places where they were required in order to bring the troops up to a wartime footing according to prearrangement. Likewise, immense quantities of livestock were similarly transported to the army canning factories and from the very outset of this wholesale stimulation of rail service the mining districts began pouring out vast quantities of coal which were borne to the naval bases.

A few hours after mobilization had been ordered the first troop trains were on their way to the fronts,

GENERAL Leonard Wood and other eminent officers of the United States Army have strongly urged of late the need of mobilizing the railroads of the country. Apart from munitions facility of transportation has more than once decided the struggle upon the battlefields of war racked Europe and the railroad played the prime part in these strategic shifts of front. The following article is an abridgment of information given to the German public by the authorities of the railroad division of the army. It covers only the first nine months of the struggle but it gives us an excellent idea of the basic organization with its workings, which has contributed so much to Teuton successes.—EDITOR.

and day by day this movement increased until the armies stood ready for service and magazines and other supply stations reached far rearward, according to previous plans for the purpose of supporting the troops under all conditions. This efficiency was the immediate result of the work done in time of peace by the railroad division of the General Staff and its various associate organizations. Plainly this readiness was born of intimate coördination with many other authorities and especially with those having normally to do with the administration of the railways. The schooling in time of peace of the military railroaders proved its great worth when the hour for conflict arrived.

A tunnel section 150 feet long being cleared for service by the Germans after destruction by the French

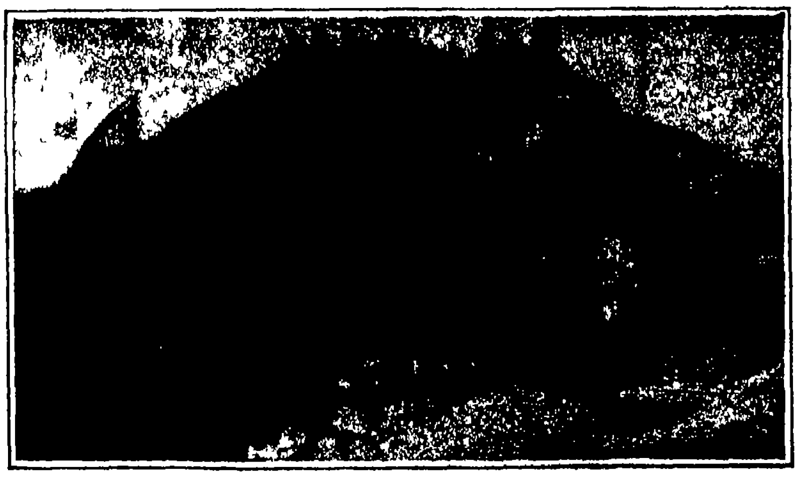
The skill of the officers in charge of the "railroad marching columns" undoubtedly contributed very largely to the German successes upon both the East and the West fronts, but it was due to them mainly that the Kaiser's forces proved victorious in their remarkable drive through Galicia. The flexibility of the railroad marching columns depends, in the first place upon a well developed network of lines, and then upon a perfect understanding of the physical characteristics of those routes bred of a careful survey of them by the General Staff in times of peace.

With the armies delivered at the fronts and the troops ready to advance, then the Chief of the Railway Division and his staff went into the field. With the beginning of mobilization the relation of the military railroad authorities to the regular railroad managements changed completely, and the peacetime organizations were at once made subject to the orders of the Chief of the Railway Division, who had the power to continue, discontinue and regulate in every way the workings of the roads.

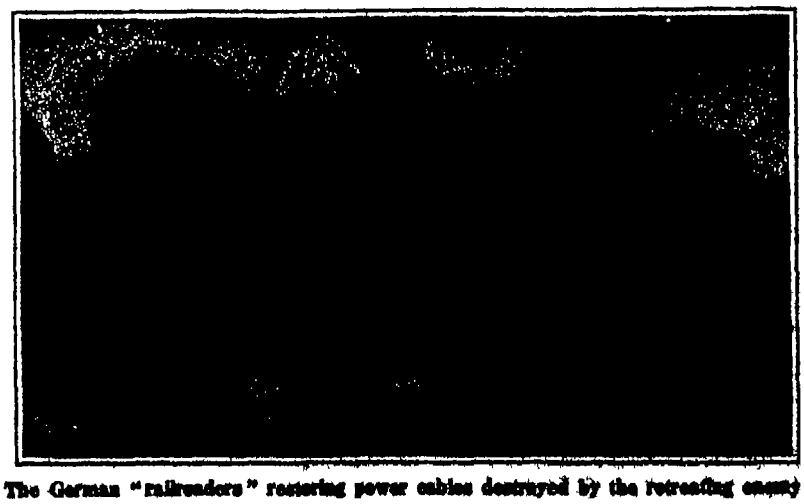
The moment the German troops entered upon enemy territory the problems of the "railroaders" became many and various. The retreating foes dynamited bridges, blocked tunnels, destroyed rolling stock that could not be moved and, as far as possible, tore up the roadbeds and effectually damaged the rails. It was of course necessary that the invading Germans should advance rapidly, and it was equally vital that the railroads should be restored and pushed along quickly behind the troops. In anticipation of just these tasks, two Military Railroad Organizations were detailed at the time of mobilization for this important work.

Organization No. 1 was in readiness at Aix-la-Chapelle for the advance into Belgium and was the first in the field and among the foremost of the invading troops. Aside from minor damages, such as torn up rails, over-turned locomotives and cars blocking the route, they found 13 bridges that had been dynamited and a tunnel choked up by running into it at full speed a number of engines purposely collided. Telegraph and telephone wires had been torn down and the operative plants of railway stations put effectually out of commission.

As in every other field of their service, the railroaders toiled ceaselessly. It was not long before they achieved



A slow and difficult restoration task for the German "railroaders"



The German "railroaders" restoring power cables destroyed by the retreating enemy

all necessary repairs and had the lines temporarily fit and, later, put them in first-class shape. Some idea of the speed with which these things were done on the western front can be gathered from this official statement of operations "On September 1st, 1914, Military Railroad Organization No. I moved into Brussels, and at the end of October it pushed on through to Lille. Newly formed organizations then took over the management of the restored roads and stations. On the 20th of August, 1914, Military Railroad Organization No. II was stationed at Diflingen. On the 25th of August it had advanced as far as Libramont, and by the 4th of September it reached Sedan" As Organization No. II moved on it was likewise supplanted by newly formed railroad working forces as far as Luxembourg. The western front finally reached such proportions that Military Railroad Organization No III was created and its head quarters were established at Charleroi

The railroad lines immediately behind the fronts are operated by the railroad troops, and linking up to these sections from the rear the service is maintained by the regular personnel of the German railroad system. This illustrates just how the peacetime and the wartime organizations are coördinated.

Following the first few months of the war, during which the railroaders were called upon principally to restore and maintain established rail routes, their work became that largely of building entirely new lines or in double tracking and otherwise amplifying existing roads. Where the German tracks stopped at the frontier it was necessary to extend them into the enemy country as far as military exigencies demanded This imposed a great many difficult undertakings. During the winter when the ground was miry, highways dreadfully cut up, vehicular traffic wellnigh prohibitive and the tracks of the rail lines in a bad condition an extensive network of tramways or field spurs was built right up to the firing lines in order to bring forward ample supplies of munitions and provisions

In place of temporary bridges, permanent ones had to be erected in course of time so as to bring up the service to a high state of efficiency and to insure safety for the heavy traffic Again in this work the railroad troops did their part in the theaters of war, while private firms in the Fatherland were called upon to do all the necessary engineering work of this sort in the rear Since the beginning of hostilities 104 big bridges have been constructed, 8 tunnels have been rebuilt, and 14 important main railroad lines have been restored to service. Besides these things, 160 railroad stations have been enlarged by adding to their yard trackage and their facilities for loading and unloading freight. Further, numerous sidings, able to accommodate the longest of military trains, and many branches, connecting main lines, have been laid

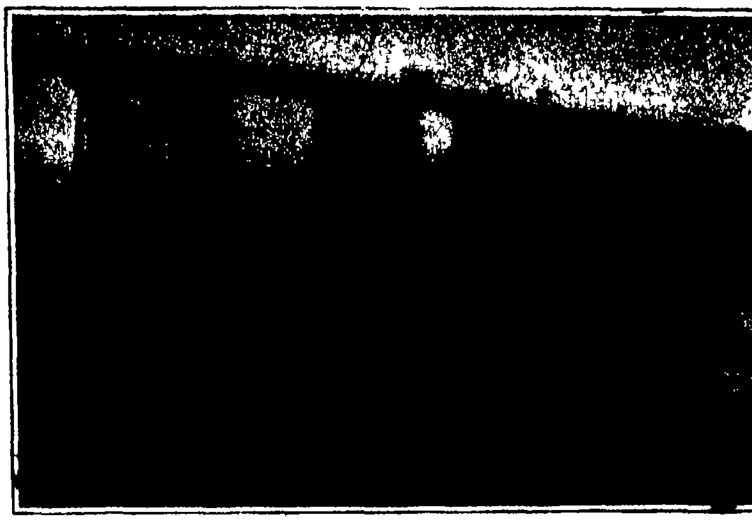
The following table gives at a glance a comprehensive idea of the German military railway service in enemy territory and includes as well the constructional work done up to April of 1915. These figures to not include the Russian roads contiguous to East and West Prussia and east of the Vistula

LENGTH OF RAIL ROUTES, IN KILOMETERS

	Single Track.	Double Track	Total.
In military service	3,000	4,100	7 100
Leased	450	150	600
Not in use	550	20	570
Not restored	90	20	110
Building	400	15	415
	4,490	4,305	8,795

SERVICE ORGANIZATIONS AND PLANTS

Administrative departments	75
Mechanical departments	25
Shop departments	10
Stations in service	1,200
Workshops	70
Gas plants	5
Electric power houses	850



The biggest wooden railroad bridge constructed in northern France by the German Pioneer Corps

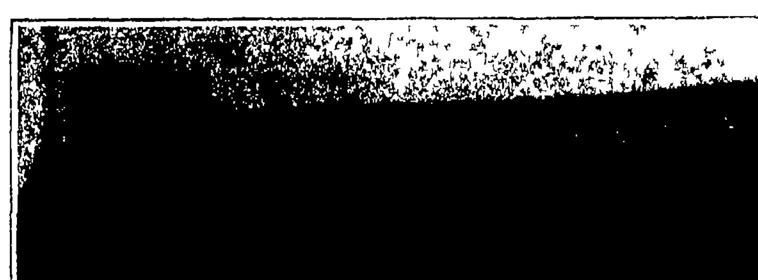
Munitions being moved to the firing line by means of tramways built by the German railroad troops

WELFARE WORK

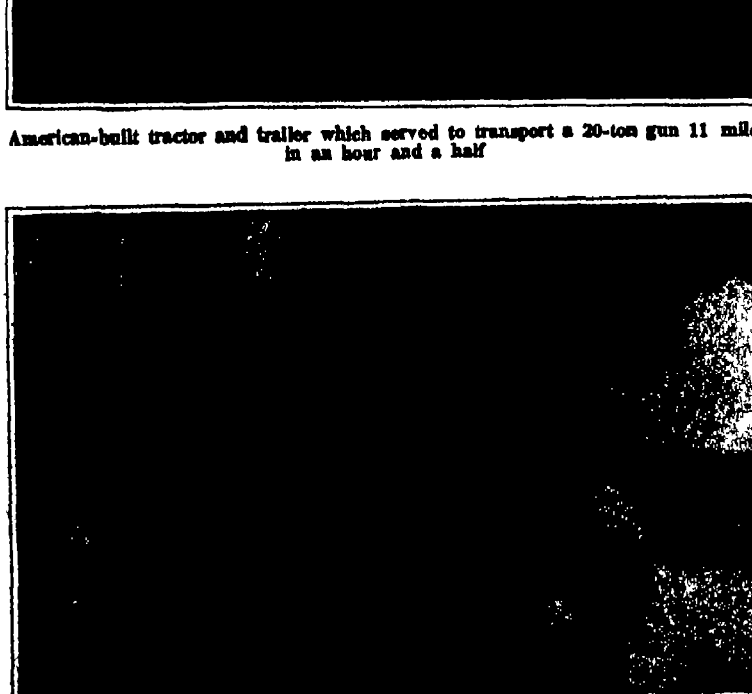
Disinfecting plants	20
Bath houses	130
Military hospitals for railroad personnel	35
Red Cross rest and first aid stations	30
Lodging houses for transient personnel	135
Homes for railroaders	5

PERFORMANCE OF ROLLING STOCK

Train kilometers	3,000 000



American-built tractor and trailer which served to transport a 20-ton gun 11 miles in an hour and a half



Twenty-ton gun transported on a two-wheeled trailer hauled by a four-wheeled American-built tractor

These activities are entirely apart from the public passenger and freight service, which was maintained all the while.

This recital shows the part advance organization and well planned coördination have played in the mobilization of Germany's railroads for military service The lesson for us is a plain one

Rapid Transportation of a 20-ton Gun by Motor Truck

IT is extremely doubtful whether many of us realize the stupendous tasks which could be entrusted to the gasoline motor in any present-day campaign of preparedness The photographic evidence offered in the accompanying illustrations is of unusual interest as recording hauling feats already performed by an American made vehicle of a comparatively new but unusually efficient type

For obvious reasons it is not possible to divulge particulars of the gun hauling feat which is here pictured However it is possible to state that the gun is approximately 20 feet long and weighs over 20 tons The vehicle supporting the forward end of the gun and serving as the propelling power for the huge load is a four wheeled American built gasoline tractor

The 20-ton gun was hauled by the powerful tractor over 11 miles of poor roads in an hour and a half The significance of this feat may be judged by the fact that with ordinary means it formerly took a day and a half to do the work

The Current Supplement

AN interesting article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT is *The Woods of Hawaii* which tells something about the different varieties of trees growing in the islands and the qualities of the woods they produce It is attractively illustrated. *The Physician and the Weather Bureau* gives some useful information concerning the effects of weather conditions on health, and the advantages the physician may derive from the information furnished in the weather reports *The World's Largest Electric Kitchen* is an account, with several illustrations of an elaborate establishment maintained by a large manufacturing company in Germany *Problems in Photo Chemistry* treats of several problems of light that will interest the scientific photographer *Calculations for Ships Forms* treats of the facts that model experiments show in regard to resistance propulsion and the rolling of ships *Protection of Life and Property Against Lightning* gives much information that is of wide value The paper on *The Structure of the Earth* is concluded

There is some interesting correspondence in relation to the illustrations of the model restorations by Mr Gilmore that accompanied the recent article on *Monster Extinct Reptiles*

The Meteorology of the Moon is an important paper dealing with the various phenomena from which lunar conditions are deduced *Insects and the War* gives much information about nuisances that are not unknown in times of peace and which are of serious importance in large gatherings of men as in the armies of Europe Other shorter articles of general interest are *The Visibility of Distant Objects in Warfare* *Using the American Ephemeris* which tells how to make your own almanac *Alcohol in War* *Quality of Limestone for Burning* and *London Traffic*

New Sludge Dryer Produced in Leeds

CONSIDERABLE attention has recently been directed to a machine for drying sludge invented and patented by a firm in the Leeds district of England It is claimed by the firm that this machine has made it possible to dry sewage sludge profitably and that it is especially suitable for drying filter pressed sludge cake containing moisture in any proportion up to 75 per cent In reply to inquiries the firm reports that the cost of converting 60 per cent sludge cake through the machine including interest and repayment of capital, has been \$1 94 per dry ton while the fertilizer is worth \$7 30 per ton and upward according to the amount of ammonia it contains.

Strategic Moves of the War, March 10th, 1916

By Our Military Expert

THE Teutonic pounding upon the Verdun salient still continues Almost regardless of losses the German battalions have been hurled headlong into the maelstrom of defending fire, through which, with perfect organization, splendid valor and seemingly unshakable determination, assault after assault has been delivered Up to Friday, March 3rd, it is estimated that 26 distinct attacks in force have been delivered under cover of the most intense concentration of shell fire ever known, with adverse climatic conditions existing, leaving the ground soft and treacherous to footing, and mostly through blinding snow

To either side of the salient proper, activities have been extended, as far to the southeastward as Metz, near Pont a Mousson and to the westward through the Argonne into the Champagne While there exist in tervals in this hundred mile line where concentrated activity has not developed, it is all part and parcel of the main assault upon Verdun, a constant pecking at the flanks of the salient that opposing troops may be held in position and that a weak point may be uncovered The jaws of the German pincers are grinding away, striving to isolate the forces defending the salient, while strong attacks continue in efforts to crush in that portion of the line nearest to Verdun, directly to the north of the city

This Verdun operation can scarcely be a direct attempt to break through to Paris, as a glance at the map will show The distance from the Verdun position to Paris is almost three times as great as that from the nearest German position on the Aisne west of Soissons A break through Verdun would inevitably result in French retirement to another defensive position in rear which would necessitate clearing before the German forces could proceed farther Southeast of Rheims, the Marne forms another stout barrier, with Chalons sur Marne and Vitry le Francois as strong points of rest, and if that line should be forced other positions lie in rear

Each assault—field besiegement—so required fearfully increases losses, in proportion to the distance from the objective, admitting Paris as objective From the Aisne to Paris offers then a proportionate saving that would certainly be seized upon were Paris the first objective It is therefore upon this relative distance deduction is made that Paris is not the present target.

But that it is the ultimate one can hardly be doubted The method of approach may be compared in a homely way with the opening of a securely nailed box A wedge is inserted at one point until a little opening is made; then another portion of the lid is attacked, further on, another one and so forth until gradually the entire nail-distance is gained Possibly the activity on the western front may resemble such an operation as the spring unfolds.

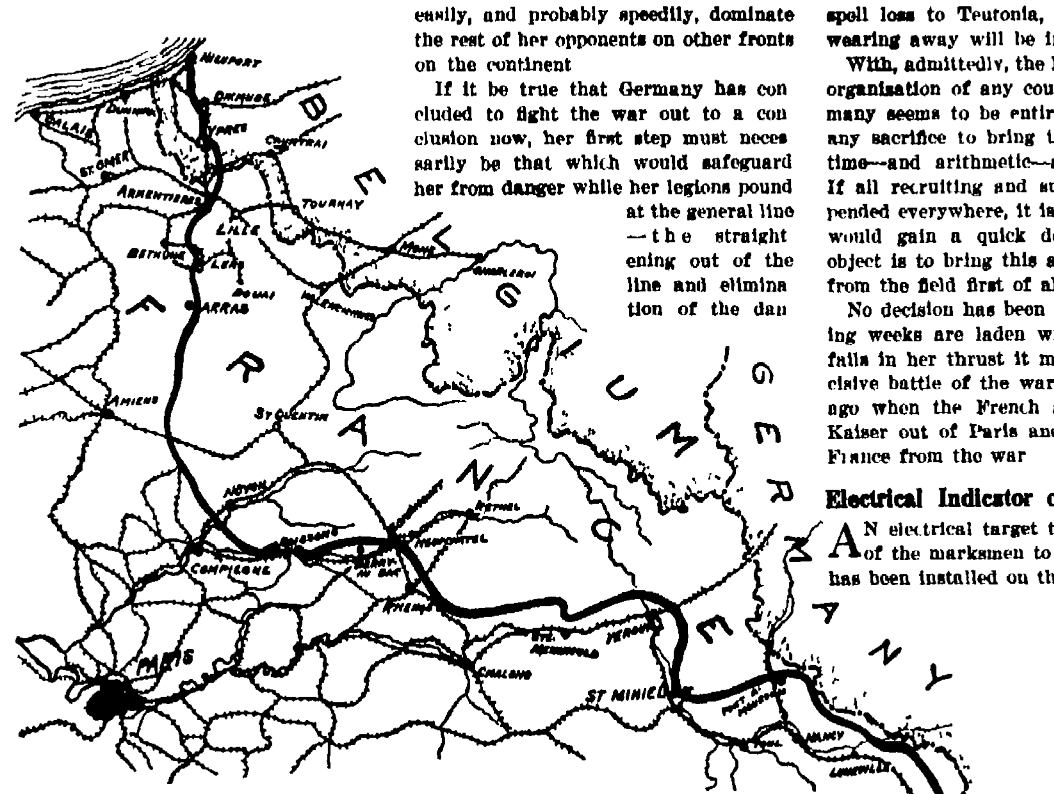
The successful penetration of the Verdun salient by Germany, to an appreciable depth would automatically require an adjustment of the French line for a considerable distance, threaten communications, or else leave a dangerous salient projecting into France which would furnish Germany interior lines for rapid shifts of force and make lateral communications for the French line extremities harder and longer It would establish a threat against much French territory and secure possession of the important railway from St. Hilaire du Temple, southeast of Rheims, to Verdun, and the Meuse, with its paralleling railway from Verdun to Toul

But the gaining of these things alone scarcely seems sufficient to counterbalance the tremendous losses which have been and will be incurred by the assailants. The great chain of the main barrier fortresses would be broken by the fall of Verdun, but that is scarcely enough in these days of huge field armies

The most important gain, short of decisive French defeat, that could accrue to Germany would be the elimination of the threat against Metz and the way into Germany, which is definitely established by the existence of the Verdun salient. The writer of these lines holds no brief for either Entente or Teutonia, but he does entertain the belief in common with many others that the cold, hard numerals of arithmetic cannot be ignored, and arithmetic as expressed in the population and resource compilations of strictly neutral and non military actuaries definitely states that the valiant Teutonic coalition is outnumbered two to one, and if the war *lasts long enough*, each side giving man for man, the stronger numerically must inevitably win

The whirlwind and spectacular German assaults upon Verdun bear this out It must be realised in Germany as well as elsewhere For Germany to win a definite decision, she must triumph speedily before a war of attrition can weaken her too much. For this reason, then, it appears entirely worth while that Germany should bend every energy towards forcing an immediate decision by sheer force of arms Despite appalling losses, despite the risk of weakening other fronts and drawing heavily upon general reserves from within the heart of the Fatherland, despite the possibility of strategic error or a definite reverse, if Germany could bring the war to a close on the western front, she could easily, and probably speedily, dominate the rest of her opponents on other fronts on the continent

If it be true that Germany has concluded to fight the war out to a conclusion now, her first step must necessarily be that which would safeguard her from danger while her legions pound at the general line—the straightening out of the line and elimination of the dangerous Verdun salient. Should that be once secured, Germany would be at liberty to bend every resource to direct assault upon Paris by the shorter route or to continue her efforts along the southward line with the object of cutting off the main body of the French army to the northward from its French territory of supply It is evident that a passive policy of waiting, in the face of superior numbers and resources could have but one result, and Germany is not waiting.



The battle line on the western front

It is claimed by many observers and statisticians that Germany has passed the zenith of her man power, through losses and the extension of her lines. That may be, but it is also the general belief that for defensive purposes there are a sufficient number of troops to man her lines so that they could be broken only with the utmost difficulty And, concomitantly, the Entente lines should be as hard to break

It would be ridiculous to believe that the Entente is willing for the war to terminate only in a draw There would then result no definite gain of any description to either side to pay for the losses incurred. The Entente tactics in the present situation are therefore puzzling. It would appear as though now is the one time for a huge offensive return elsewhere, either on the western front at another point, or on the eastern, by Russia But with the exception of somewhat sporadic activities by the British in Flanders, the other sectors seem silent as so many tombs. Weather conditions may account for the withholding of a Russian thrust, for the ground at present does not favor handling of troops and supplies by road, with railways lacking to adequately cover a long general front. There must be at least 4,500,000 Entente troops, British, French and Belgian on or in rear of the western line, which would leave at least a million men available for a thrust. Naturally, if such a thrust is in preparation, every effort will be made to conceal it until such time as it is forthcoming, this may account for the apparent torpor.

Again, it may be that France feels so secure behind her defenses, that she is willing for Germany to dash her spiked head against the holding lines and count the cost afterwards. Such losses, which must necessarily be greater to an attacker than to the defense, would count in the policy of attrition, and perhaps France is still carrying on the tactics that have signalized her campaign since the battle of the Marne. Perhaps a massive counterstroke will be delayed until a decision has been reached in the battle of Verdun when, if the French lines hold, it will have been demonstrated rather definitely that deadlock in truth does obtain and that even more time must be consumed in attrition before the opposing forces are sufficiently weakened to render successful Entente assault probable.

Each day gained without a decision means so much benefit to the ponderous Bear, the country that in the end will probably count heaviest through her unwieldly strength, each time-gain aids unprepared England, France is probably now at her greatest strength

And each day that passes without decisive result must spell loss to Teutonia, even though it be small, the wearing away will be in progress

With, admittedly, the highest development of military organization of any country engaged in the war, Germany seems to be entirely justified in making almost any sacrifice to bring the war to a speedy close, for time—and arithmetic—are her most feared enemies. If all recruiting and supply activities should be suspended everywhere, it is highly probable that Germany would gain a quick decision, and her most sought object is to bring this about by elimination of France from the field first of all

No decision has been reached thus far and the coming weeks are laden with moment. But if Germany fails in her thrust it may safely be said that the decisive battle of the war was fought almost 18 months ago when the French stand on the Marne kept the Kaiser out of Paris and prevented the elimination of France from the war

Electrical Indicator of Scores for Rifle Ranges

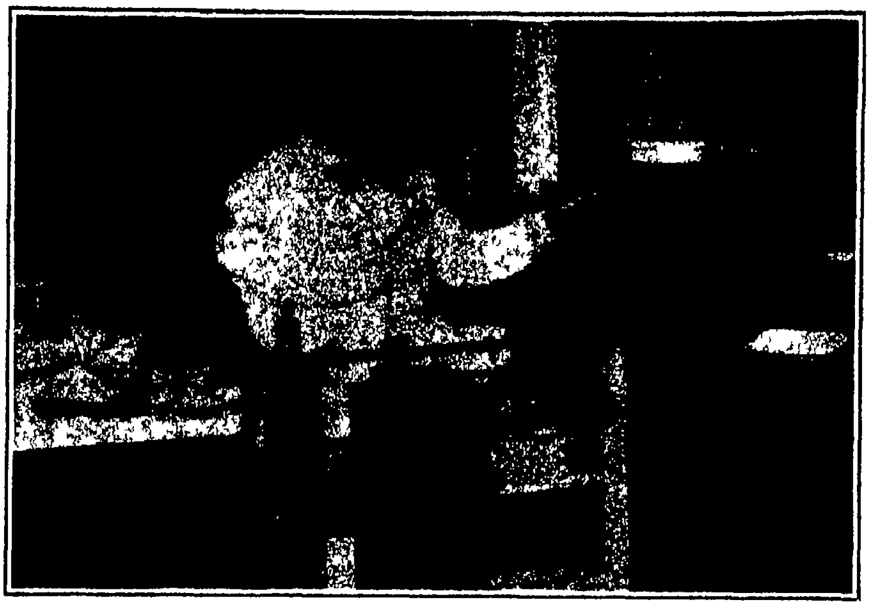
AN electrical target that signals the exact accuracy of the marksmen to an indicator on the firing line has been installed on the shooting range of the United States Marines at San Francisco The method of signaling the accuracy of shots now employed on most Government ranges has been criticised, as it has been difficult to convey to the men on the firing line the explicit information as to the closeness of his shot to the bullseye An elaborate system of flag and disk signaling is usually employed. This requires on long-distance ranges the use of field glasses When the marksman fires a shot at a target the spotter in the distant pit lowers a target and raises a signal to denote the numerical accuracy

The procedure requires a large corps of men both in the pits as spotters and on the range behind the marksmen as scorers. Moreover, it has often proved confusing and there is no way of signaling whether the bullet that missed went too far to the right or to the left, too high or too low

The electrical target in appearance resembles a number of large ventilating fans superimposed one upon the other, each one smaller than that beneath it. The bullseye is a thick metal disk, painted black, which extends in front of the blades. Steel plates are used in the construction and behind the steel plates are electrical contacts.

On the firing line is an electrical indicator, which in design is a replica of the target. Each leaf of the target is represented by a minature electrical lamp on the indicator When a bullet strikes one of the blades of the target, the contact made closes an electrical circuit, consisting of batteries, a cable to the indicator, and one of the lights of the indicator. The action is immediate, the marksman knowing at once not only his score but the exact place on the target where the bullet struck, so that he can adjust his rifle sights to conform with wind and temperature conditions. The target and indicator are marked to resemble a clock face.

Peeling potatoes with the use of an adjustable clamp



Complete kitchen equipment for the one-armed soldier-cook

Kitchen Equipment for the One-Armed Soldier-Cook

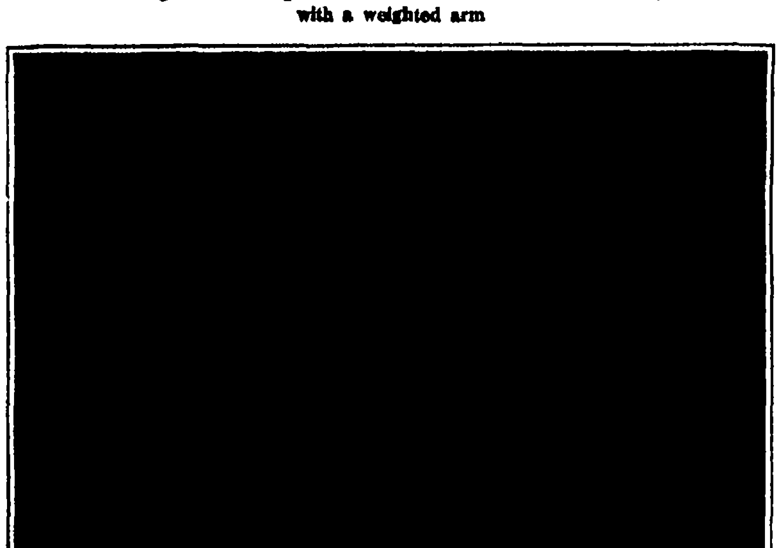
IN view of the many operations involved in the cooking of an ordinary meal, not a few of which are at once delicate and complicated it would appear that this occupation is not one to be engaged in by a one armed man Yet recently there has been demonstrated in England the feasibility of one-armed cooks in the near future, indeed, the culinary field offers a most attractive opportunity for many of the war's victims who have lost the use of one of their hands

In its untiring endeavors to create tasks and occupations for disabled English soldiers, the *Society of Medical Officers of Health* has found a promising field in the kitchens of hotels, restaurants and even households. Recently the secretary of the organization, William Lawton, gave an interesting demonstration of the use of a number of simple contrivances and a specially constructed stove which he has devised to enable a one-armed person to undertake the numerous duties of a cook All of the contrivances which he used are of the simplest sort, in fact, they may be made by any one from odds and ends usually found about the house, and from clamps procurable at any hardware store

In the four accompanying illustrations are depicted the simple contrivances devised by Mr Lawton, as well as the method of using them. In the first view is shown a simple clamp, which serves to hold potatoes or apples which are to be peeled It will be noticed that the clamp is adjustable so as to take any vegetables or fruit irrespective of their size While allowing that this method of peeling may perhaps be cumbersome as compared to the usual procedure, it is claimed that with proper practice the user soon becomes skilled in the work. In another illustration is shown how a chicken is held securely while being cleaned and dressed, the device in this case consisting merely of a hinged metal arm on the free end of which is placed a heavy weight. On the arm is an adjustable fork like member which may be used for holding the chicken, or for that matter any other kind of meat, should it be found necessary How an egg may be readily broken with one hand without losing any of its contents is shown in another view, in this instance a trough shaped piece of sheet metal with a sharp ridge is used to break the egg cleanly in half and gather the yolk and white of egg into the dish below The meat chopper, which is conspicuous in this and other views, is an indispensable tool of the one-armed cook. In the remaining view appears the entire equipment devised by Mr Lawton, including the special stove, which in this instance is of small size and presumably intended for the usual household. This stove is made in the form of an oven, with wire-work shelves for holding the different foods that are to be cooked.

Mr. Lawton has devoted considerable thought to the devising of the various contrivances whereby a one-armed person can cook almost as readily as the more fortunate individual. In order that his demonstrations might be conducted under the most realistic conditions, Mr Lawton had one of his arms tightly bandaged across his chest so that it could not be used

Cleaning and dressing a chicken with one hand, while holding it with a weighted arm



Breaking an egg with one hand, using a trough-like device

False Flax, A Little-Known Plant of Value

AMONG the little known plants which have been introduced from Europe is the false flax or gold of pleasure It was first brought into this country as an impurity in flaxseed and clover seed and it is now pretty generally distributed wherever flax is cultivated The false flax is a member of the mustard family of plants and is called *Camelina sativa* by botanists. Its generic name is derived from the Greek meaning false flax, so-called because it invariably grows with flax which it resembles in a general way, only it is slightly smaller and its seed pods are pear shaped instead of spherical.

Although false flax is regarded as a weed in cultivated fields it is nevertheless a plant of considerable merit and should be drawn to the attention of agriculturists and others as an oil plant adapted for feeding cattle and for other purposes It forms a well known crop in Europe and its cultivation there dates back to the eleventh century From that time on it has been planted more or less extensively in Holland Germany Russia and Turkey It is believed that its cultivation in this country would repay the farmer because an acre of false flax yields about 32 bushels of seed of which from 30 to 32 per cent is oil which exceeds that of true flax Judging from observations made in this country it flourishes on barren sandy soils where no other crops will grow successfully Being independent of drought the plants grow vigorously and yield a large crop It does not exhaust the soil like the corn crop for instance but it may be planted after the corn crop without doing the least injury to the land

The best time to sow the seed is in the fall requiring about 15 pounds of seed to the acre sowing it broadcast The seeds will germinate in the fall and produce a rosette of leaves similar to dandelion In the spring the plants will develop stalks which mature the seed pod in June and July Care must be taken to cut it before it becomes too ripe or the seed will be lost As soon as the pods change from green to golden, they are ripe and should be harvested and prepared for market in the same manner as wheat and oats The cultural methods for this plant are the same as those for true flax

The false flax seeds produce a finer oil than rape or true flax besides the use of the seeds for oil which is employed in the manufacture of soap lubricating oils, etc the oil cake has been found highly nutritious in the fattening of cattle and sheep These cakes constitute masses of seed from which the water and oil has been deprived by mechanical means. Not only are the seeds valuable, but the stems of this plant yield a fiber which is used in parts of Europe for making coarse cloth.

Leaf Margins as an Indication of Climate

A RECENT paper by Messrs I W Bailey and E W Sinnott calls attention to a striking correlation between the character of leaf margin especially in trees and large shrubs and the prevailing climatic influences a relation that is of interest in studying the climates of past geological ages Leaves and leaflets with entire margins (i e not broken by teeth or serrations) are overwhelmingly predominant in lowland tropical regions, those with non entire margins in mesophytic cold temperate areas In the tropical zones non-entire margins are favored by moist uplands equable environments and protected comparatively cool habitats, in the cold temperate zones, entire margins are favored by arid environments The authors suggest that "the determination of the percentages of entire and non-entire leaves in Cretaceous and Tertiary dicotyledonous floras affords a simple and rapid means of gaging the general climatic conditions which existed in the regions where these plants flourished"

The Motor-driven Commercial Vehicle

Conducted by VICTOR W PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles

Foreign Motor Truck Subsidy Requirements

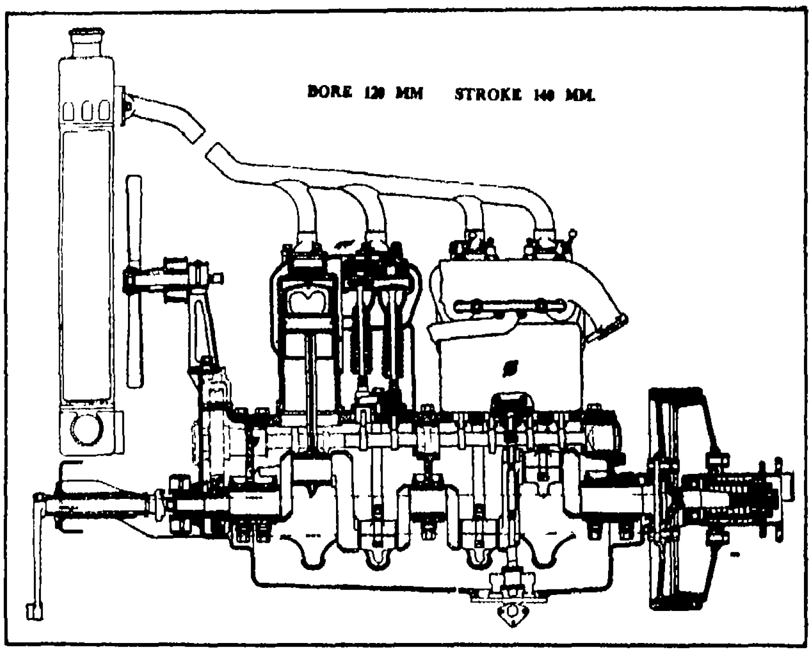
LONG before the outbreak of the present war the belligerent powers had understood that the motor truck would be of marked utility, not only for transporting the munitions of war, such as food arms, aeroplanes and the personal impedimenta of large bodies of men, but also for conveying the soldiers themselves It is apparent that an enormous sum of money would be involved if the various governments were forced to purchase outright a large enough number of vehicles for war purposes and not only would capital be tied up but the motor trucks would remain idle until the outbreak of hostilities made their use necessary

The solution of this problem was that all who owned motor trucks which were built to follow certain basic requirements could, by suitable registration avail themselves of the financial assistance provided by the subsidy, which meant that they would receive a regular stipend issued periodically, or a large cash payment that would be of material assistance in helping pay for the trucks In case of war, all the trucks must be delivered to the government upon its request and a definite previously agreed upon price, given to the owner of the vehicle

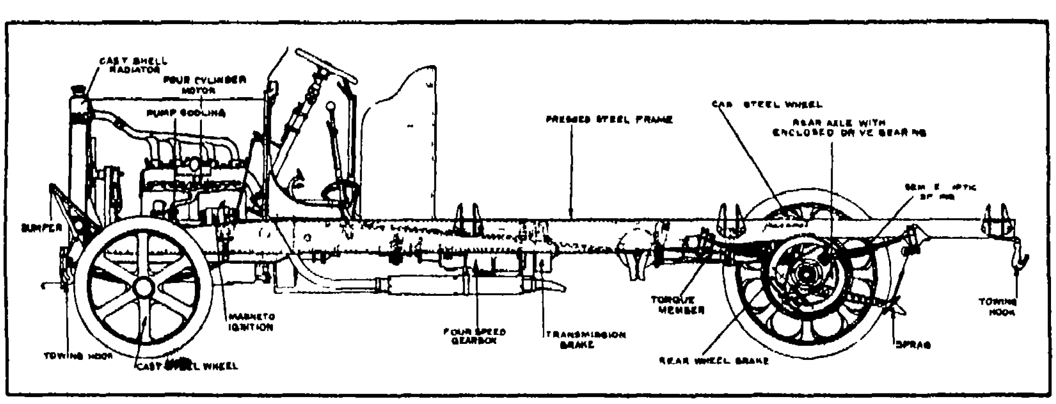
It will be apparent that in operating thousands of commercial vehicles, it would be highly desirable to have all of these conform to certain standards, in order to reduce the expense of maintenance and to insure continued operation of the trucks. It was the endeavor of those responsible for the subsidy rules to have as many as possible of the components of the various trucks interchangeable to some extent, even if these were of different makes

In view of the present agitation on the subject of adequate preparation of defense in the United States it would seem desirable that some effort be made to standardize certain types of trucks as being best adapted for war service and even if no subsidy were offered it is highly important that a set of rules be formulated by competent engineering authorities in the employ of the government so that builders of trucks could design certain types that would be similar in many respects to those of like pattern built by other manufacturers There are, at the present time, several hundred different models of motor trucks produced in the United States and while all of these fill a logical demand in the industrial field it is very unlikely that they are all suitable for army purposes

In order to show how the foreign trucks subject to the subsidy have been standardized we will review briefly the most important specifications, so that those familiar with motor truck construction can judge which of our American motor trucks would be preferred by European governments Considering first the British specifications we find two types of trucks are considered desirable the type A being of three tons capacity while the type B is of 1½ tons capacity The body type is a simple platform with detachable sides 2 feet high The tires of the type A truck are 900 x 120 millimeters single, for the front wheels and 1050 x 120 millimeters, dual for the rear wheels These are equivalent to our American dimensions as follows 35.40" x 4 72" front, 41 33" x 4 72" rear. On the type B or lighter truck the front tires must be 870 x 100 millimeters single, and the rear are 1,030 x 100 millimeters, dual. The wheels should be of steel, 881 6 millimeters diameter (34 724") for the 1,030 and 1,050 millimeter tires and 719 8 millimeters (28.25") for the 870 and 900 millimeter tires



Typical four-cylinder engine used on English class A subsidy trucks



Side elevation of class A subsidy model three-ton chassis that conforms to the English requirements

The power plant of the type A trucks are four-cylinder engines having a minimum bore of 4½ inches at a minimum rating (R A C) of 30 horse-power The type B engine is also a four cylinder pattern having a minimum bore of 4 inches and a minimum rating of 24 8 horse power The cylinders are to be cast in pairs having mechanically operated valves with enclosed valve stems. The motors should be provided with automatic speed governors and cooled by pump operated cooling systems The power plant and its auxiliary units must be located at the front of the chassis, under the bonnet, and all parts must be accessible for inspection or adjustment. The ignition is by high tension magneto having the shaft center 50 millimeters from the supporting flange or base piece. The radiators must be the tubular form having substantial cast metal frames and must be located above the frame. Two outlet connections are to be provided and the radiator must be protected from damage in event of collision by a bar Lubrication must be by positive driven mechanical pump and the system must have oil capacity for 200 miles.

The transmission should have four speeds forward and one reverse and should be geared to have a ratio of at least 5 to 1 on high Shaft drive is specified and torque members and radius rods must be provided as the springs are to sustain only the weight of the vehicle and not to resist either braking or driving torque. The hand brake lever must operate so that it is necessary to push it to set the brake. The foot brake is to operate on the propeller shaft as foot brakes operating on rear wheels will not be accepted The hand brake acts on the rear wheel hubs Either brake must hold the vehicle on a grade of 1 in 5 The wheel base of the type A must not be less than 156 inches while that of the type B must be a minimum of 120 inches. A 30-gallon fuel tank should be fitted. The gasoline consumption should not be greater than one gallon per 40 ton miles. Engines must develop their R.A.C. rating The truck must be able to climb a grade of 1 in 6 fully loaded. Two towing hooks must be fitted to the front and

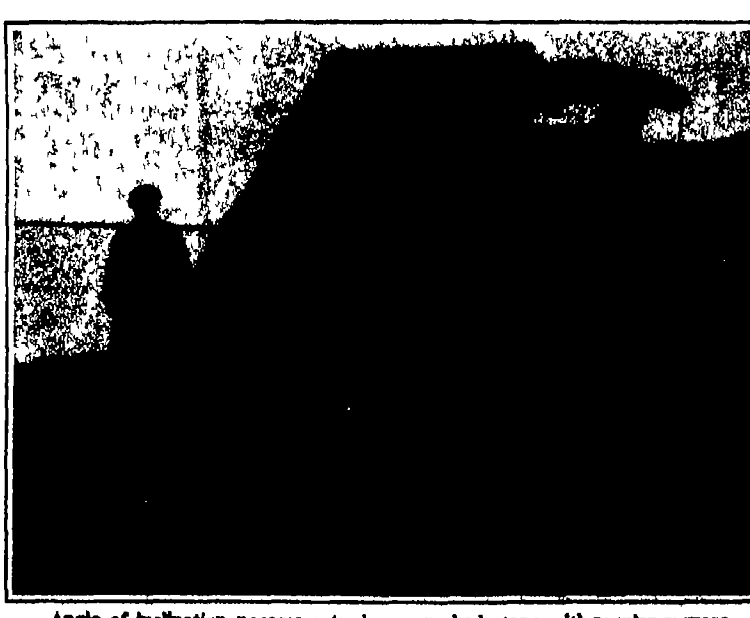
(Concluded on page 311)

Motor Truck Queries

W V H writes We are designing a special dumping body for use on one of our five-ton chassis intended for general contracting work and hauling materials for road construction What degree of elevation would be required to have various materials flow by gravity Are there any data available on this subject? What is the best material to use in body construction? A By all means use either a steel body, or at least, a steel lined wooden body Wood used alone would soon be worn away by the materials hauled, and besides, it will have to be tipped more to dump clinging materials, such as wet ashes, than a steel body will. A series of tests by Morris A. Hall gives the following minimum angles with the horozontal at which various materials can be completely dumped from a flared side, steel lined truck body

Material	Angle Degrees.
Dry ashes	33
Wet ashes. . .	34 to 36
Very wet ashes	29 to 30
Concrete or garbage .	30
Sand ...	29
Broken stone, No. 2 sand	27
Soft coal.. .	30
Coke	28

From the foregoing it will be evident that an angle of inclination of 35 deg. will take care of any material used in road construction. The reason it takes less inclination to dump very wet ashes, concrete or garbage than dry ashes or barely wet ashes is that water becomes a lubricant if used in large quantities and acts only as a binder if used in small amounts. Bear in mind, the interior of the body should be smooth as possible and lining bright. Projecting bolt heads, cleats, braces, nuts or rivets will retard the flow of the material when the body is raised.



Angle of inclination necessary to dump crushed stone with regular express body construction

Industrial Preparedness for Peace

(Concluded from page 300)

which it will leave the world. It would therefore be equally impossible to speak definitely of business preparedness. This, however, we can say When the war closes, there will be a sudden cessation of demand for many manufactured articles and a corresponding decline in price The price of agricultural products will also decline, and business generally will be disturbed The best way to prepare is to reform present habits of extravagance, put by profits being made now for a rainy day Wages, of course, must decline with lower prices, and there will no doubt be many industrial disturbances and much suffering throughout the world, all of which the world will richly deserve as it is engaged in the most barbarous warfare in all its history Foreign competition will, of course, be keener than ever before and the Government should do all in its power to foster and assist our business interests, or, at any rate, as the man said in his short prayer to the Lord during a tussle with a grizzly bear 'Oh Lord, if you can t be on my side, please don t be agin me!'"

Prof THOMAS N CARVER, Department of Economics, Harvard University

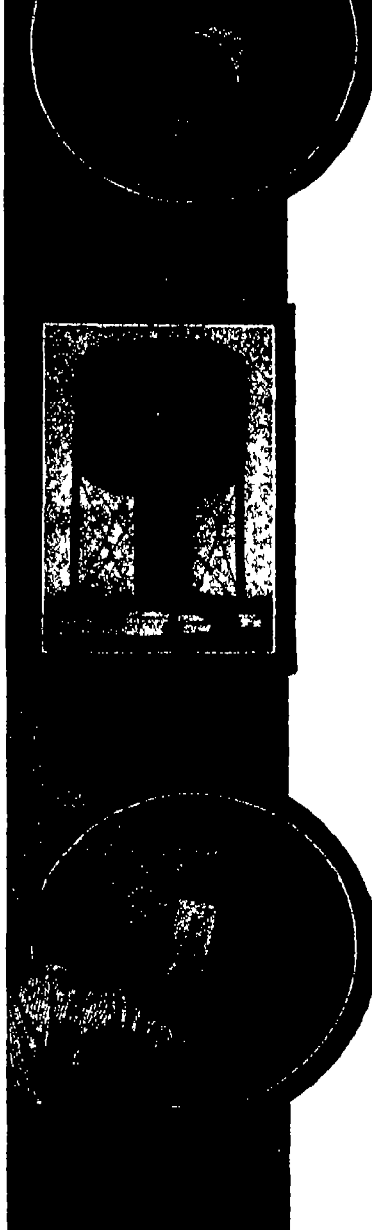
"In the *New York Times Annalist* for January 3d, I have an article on the subject of redistribution of population following the war That will give you my opinion regarding some of the questions which you raise in your letter of January 8th I read a paper before the Pan American Congress entitled 'The Conservation of Human Energy,' which gives my views regarding some other problems connected with your subject, namely, 'Industrial Preparedness for Peace'

"I may say that in my opinion purely business questions and questions of shop management, business efficiency, etc. while important in themselves, are secondary to more fundamental questions such as the morality and self discipline of a people The greatest of all industrial engineers is the moral leader, provided his moral system is rational Real immorality is nothing in the world excepting waste or dissipation of human energy Real morality is nothing in the world except the economy and utilization of human energy The reason it is better to tell the truth than to lie is because a community in which truthfulness prevails will waste less energy than a community where lying prevails. There can be team work and economy of effort in an honest community, there can be no team work, but only waste of effort in a dishonest community Honesty is one of the greatest labor-saving inventions ever devised This may be said of any other form of morality which is genuine and not merely conventional Therefore, it seems to me that economists, business men, and statesmen should give more attention to those fundamental moral questions which are all reducible to the economics of social energy Our greatest waste is the waste of men A man goes to waste when his productive energy is not fully utilized, when he is dissipating it in private vice, or when social morality is so poorly developed that he has to spend his time watching his neighbors, and they likewise have to spend their time watching him.

"Again, litigation among the citizens of a country is only a little less wasteful than war To kill men in war stops their productivity, but it also saves their feed. For a man to spend his time, as a lawyer in fighting private battles, destroys his productivity just as effectually as though he were killed, and you do not save his feed but have to go on feeding him just the same as though he were producing something. In short, the more people we have engaged in non-productive litigation, the fewer we have left to do the productive work. When we realize that we support more lawyers and waste more men in court proceedings than any other country, we will [illegible]

America's Leading Railroads Use Armco Iron— the Iron That's Made to Last

Armco Iron polished sheets were used for the boiler jackets of 35 locomotives. Mikado type by the American Locomotive Company, for the M K & T R R.



THE leading railroads of America quickly gave rust-resisting Armco (American Ingot) Iron a trial as soon as it was made in commercial quantities.

They used it first in a few culverts. Today thousands of Armco Iron culverts are resisting the corrosive action of impure water along the railroads and are standing up under the pounding of the heaviest freights of our history. This service led to broader uses. Armco Iron roofing and siding proved their worth because

ARMCO IRON Resists Rust

Armco Iron now goes into freight and passenger cars, locomotive boiler jackets, boiler tubes, equalizer bars and fence posts, Page Wire Fencing, (Monessen, Pa.) Water tanks, gasolene and oil storage tanks, ventilating ducts, window frames, metal lath, tie plates—these are but a few of the products that are more durable and hence cheaper when made of this metal

Rust-Resisting Property was one of the special characteristics of Armco Iron recognized by the metallurgists who awarded Armco Iron the Grand Prize, the highest possible award, at the Panama-Pacific Exposition

The great rust-resistance of Armco Iron is due to its remarkable purity, and to the scientific care and rigid inspection which characterize its manufacture Armco Iron has unusual workability, superior enameling quality, perfect welding properties and high electrical conductivity

Write for "Defeating Rust"

Let us send you this book—the truth about rust and how Armco Iron will save you money by resisting the great destroyer Send for book and data on the product of interest to you.

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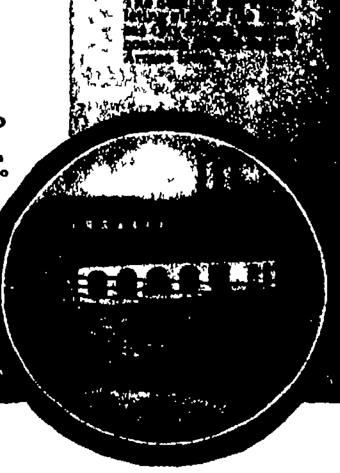


The roofing of this ca[illegible]e of Armco Iron

point the finger of scorn at the militant nations.

"The real source of wealth and prosperity is the fund of human energy, or power to do productive work, both mental and physical. The more this is wasted in vice or dissipation, in idleness or leisure, in luxury or over-consumption, in ignorance or lack of skill, in litigation or internal conflict, in unscrupulous bargaining or predatory enterprise, the less there is left for the really productive work which alone can create prosperity When we consider all these possible sources of waste, we shall find that war is not necessarily nor always more wasteful than peace It is quite possible, and by no means uncommon, to waste more in the vices of peace than in the destructiveness of war"

A B CUSHMAN, General Manager, National Grocer Company, Detroit

"The writer has heard some talk regarding the possibilities of extending trade relations in our line to South American countries, but unless these countries discontinue the tariff on American canned goods, little or nothing can be accomplished. I believe that trade relations with all countries is a subject which needs our earnest consideration now and it should be scientifically considered A Tariff Commission should be named whose duty it would be to gather statistical information from all countries and record it in such way as to make it available when Congress has occasion to act on tariff matters

Million-Volt Commercial Frequency Transformer

(Concluded from page 299)

capacity types of this device may be connected directly to very high potential mains for stepping down the current thus bringing about a tremendous saving in installation and affording the small consumer and the far distant one an opportunity hitherto denied him by both excessive cost and inaccessibility of power

The transformer could be safely operated for six hours at 200 per cent over load without injury to the insulation, due to the excellent cooling surface of all primary and secondary coils It could be safely operated for 24 hours at 100 per cent overload It could stand a short circuit on the secondary for five minutes with the primary operating at full potential

The demonstration areas on the exterior of the building were fitted up by engineer A S. Lindstrom, assistant to the inventor and in charge of the installation and operation of the coil, with numerous devices designed to collect and convey electrostatic charges generated by the coil To admit of crowds to experiment individually and collectively with this electrostatic energy, he brought out of the transformer house by means of long prepared rope insulators, the million volt end of the coil and connected it to a wire screen formed of bare crossed wires 50 feet square and suspended 30 feet above the earth Some idea of the strength and effect of the electrostatic stress contained in this overhead system when energized by 400 horse-power at a potential of 500 000 volts may be had from the fact that when an automobile drove up on its insulating rubber tires to a point within 25 feet of the screen a person could step up and draw a spark and shock from any metal part of it.

At a point 10 feet beneath the charged wire screen a second insulated rope screen or protecting net was arranged. So great was the charge it carried under the same conditions that the writer himself drew from it with a grounded conductor sparks 2 feet in length, accompanied by miniature thunder claps.

On the ground beneath the rope protecting screen dozens of persons at a time were nightly beheld moving about under difficulty through the energized space, like divers penetrating their way through water A person could there stand on an insulating box and impart sparks 3 and 6 inches in length to other individuals; and even the face when held skyward felt the energy being dissipated from it to

various forms, one evidence of which was in the easily *detected presence of ozone* forming at the very nostrils. When standing on the ground the hat could be raised off the head by one hand with a discharge of sparks and prickling sensation. If held in the air, a half inch spark could be drawn from the hand by the thumb of the same hand. When the hat was held near the head the same sound or hum that is experienced in the presence of alternating current generators was audible When vacuum or Neon and Helium gas tubes were brought under the charged screen all manner of interesting displays occurred therein One striking result was the visible effect of the passage of the alternating charges of positive and negative potential in flowing between the screen and the earth, when the vacuum tubes were held perpendicular and moved slowly back and forth horizontally At different positions in the horizontal movement they would catch a positive or a negative flow and exhibit it to the eye, there being a separate form for each kind of potential Strange unexplained behavior of the tubes also occurred, proving in the existence of such a hitherto unachieved condition of electrostatic stress a new and fruitful field of scientific research When the outdoor aerial system was charged to a high degree it became luminous, some parts showing a corona of 6 inches about them One of the interesting spectacular demonstrations was that of causing great surges throughout the system by intermittently discharging the stress in the screen to a grounded jet of spouting water breaking upward on a suspended metal disk, the latter being connected to the screen. The resulting noise was terrific, the sight beautiful yet awe-inspiring, and the magnitude of the corona and luminosity startling

Foreign Motor Truck Subsidy Requirements

(Concluded from page 306)

two to the rear Two independent sprag bars located on the rear axle must be easily operated by a handle at the driver's seat

The French specifications do not go into such minute detail There are three classes of trucks, the largest one of 4,408 pounds capacity or about two long tons The Colonial truck should have a capacity of 3,306 pounds, while the four wheel drive trucks a classification that we do not find at all in the English specifications have a carrying capacity of 3,306 pounds, this not including the load on trailers operating in conjunction with them The body type is a platform with box and cover The regular top is the form used on the well known American prairie schooner The front tires may be from 770 to 1 000 millimeters in diameter (30 to 40 inches) and 90 to 180 millimeters in width, single (3½ to 7 inches) The rear tires must be 205 to 325 millimeters in width, dual (4 to 12 inches) Tires must be solid rubber No pneumatic, cushion or block tires accepted

The engine must be a four-cylinder form fitted with high tension magneto Greater latitude is allowed than in the British specifications as no attempt is made to dictate the character of the cooling or lubrication system or the dimensions of the engine. The transmission must have four speeds forward and reverse The braking capacity must be such that the vehicle can be stopped with but one set of brakes within 50 meters (160 feet) on a 12 per cent grade The towing hooks and sprag requirements are the same as in the British specifications. The fuel tank must have capacity for 200 kilometers (125 miles) and the water capacity should be sufficient so that the same distance can be covered without any need of replenishing the supply The engines must operate with gasoline, alcohol, or benzol. Fuel consumption must not exceed six centiliters per ton kilometer for any kind of fuel. Consumption of lubricants must not exceed 5 grams (about five fluid ounces per ton mile) per ton kilometer or [illegible] per ton mile. The truck must be able to tow another [illegible] up an [illegible] per cent grade. [illegible]

specifications as suitable for the requirements in the United States, though very complete specifications of trucks adapted for our use should be prepared and submitted to all manufacturers of trucks by the government. It would seem that our peculiar highway conditions would make a class that would cover the four wheel drive truck just as imperative as in France It would be wise also to limit the power plant to four cylinders and have only four speed gear boxes Final drive by entirely enclosed drive gearing is preferable to any other form and the control could be standardized to advantage

Operating Trains Across the Great Divide

(Concluded from page 298)

bring to bear considerable influence in causing other railways to electrify entire divisions of their roads

The electrical power employed to supply the extended electrical zone of the railroad is obtained from a power company The entire 440 miles of the route is supplied from fourteen sub stations spaced at intervals of about 35 miles each of which contains transformer equipment for stepping down the 100,000 volt alternating current to 2,300 volts, and motor generator sets of either 1,500 or 2 000 kilowatt capacity, which furnish 3,000 volts direct current to the overhead feeder from which the locomotives obtain their power In this respect the Chicago, Milwaukee & St Paul Railway is unique for it is the first direct current installation supplying current of such a high potential to the locomotives through the trolley wire, although the system was adopted in preference to all others after a careful investigation extending over two years

The overhead trolley construction is of the catenary type, in which two No 0000 trolley wires are flexibly suspended from a steel catenary supported on carefully selected cedar poles the construction being ' bracket " wherever direct alignment will permit, and "cross span" on the sharper curves and in the yards Steel supports instead of wooden poles are used in the yards where the number of tracks to be spanned exceeds the possibilities of wooden pole construction The twin conductors of the trolley system are suspended side by side from the same catenary by independent hangers alternately connected to each trolley wire This form of construction permits of the collection of very heavy currents by reason of the twin contact of the pantograph with the two trolley wires, and also assures sparkless collection under the extreme of either heavy current at low speed or more moderate current at very high speed It appears that the twin conductor type of construction is equally adapted to the heavy grades, calling for the collection of very heavy currents, and on the more level portions of the line where maximum speeds of sixty miles per hour are reached with passenger trains having a total weight of 800 tons.

Under normal conditions forty two immense electrical locomotives are required to haul freight and passenger trains over the electrified mountain divisions of the Chicago, Milwaukee & St Paul Railway These new engines, described at length in the SCIENTIFIC AMERICAN, Vol CXIII, No 19 page 392, resemble two large mail cars permanently coupled together They weigh 284 tons each and will haul 3,200-ton loads trailing up a 1 per cent grade at an average speed of 15 miles an hour Similar electric locomotives geared for a greater speed will haul 800-ton passenger trains over the same road at a speed of 60 miles per hour To appreciate the immense tractive power of these locomotives one should know that the wood burning locomotive of fifty years ago weighed 20 tons and had a tractive effort of only 5 000 pounds The present day Mallet steam locomotive has a tractive power of 76,200 pounds, while the electrical locomotive weighing 284 tons has a tractive power *of 85,000 pounds.* The Chicago, Milwaukee & St. Paul electric locomotives are 112 feet 8 inches in length, and are driven by eight separate 430-horse-power motors, each geared to a driving axle, thus giving

a total of 3,440 horse-power On down grades the trains are controlled by regenerative braking, that is to say, the motors are caused to act as generators, which exerts the required braking power and at the same time returns an appreciable amount of current back into the line.

The electric current for operating the electrified section of the road, as previously stated, is purchased from a power company This company covers a great part of Montana and part of Idaho with its network of transmission lines, which are fed from a number of sources, of which the principal are as follows Madison River 11,000 kw Canyon Ferry, 7,500 kw Hauser Lake, 14,000 kw, Big Hole, 3,000 kw, Butte (steam turbine), 5,000 kw Rainbow Falls 21,000 kw, and small falls aggregating 7 390 kw In all, these sources are to-day developing 68,890 kw, and further plans which are now in the course of realization will eventually add another 175,000 kw to that figure, making a total of 244,000 kw

The several power sites are interconnected by transmission lines, the earlier ones are supported on wooden poles and operate at 50,000 volts and the later installations are supported on steel towers and operate at 100,000 volts Ample water storage capacity (300,000 acre feet) is provided in the Hebgen Reservoir, and this is supplemented by auxiliary reservoir capacity at the several power sites, which brings the total up to 418,000 acre feet. The Hebgen Reservoir is so located at the head waters of the Madison River that water drawn from it can supply in turn the several installations on the Madison and Missouri rivers, so that the same storage water is used a number of times, giving an available storage capacity considerably greater than is indicated by the figures given. It would seem, therefore, in changing from coal to electricity as a source of motive power, that the railroad is amply protected as regards reliability and continuity of power supply Due to the great facilities available and the low cost of construction under the favorable conditions existing, the railway company purchases power at a contract rate slightly more than one half cent per kilowatt hour, based on 60 per cent load factor Under these conditions the cost of power for locomotives is considerably less than that of a steam locomotive doing the same work.

NEW BOOKS, ETC.

THE UNIVERSE AND THE ATOM The Ether Constitution, Creation and Structure of Atoms, Gravitation, and Electricity, Kinetically Explained. By Marion Erwin C E. New York D Van Nostrand Company, 1916. 8vo, 314 pp., illustrated. Price, $2 net.

Since recent developments seem to indicate that the atom is not indestructible, and the universality and general transfusion of energy seem to preclude the existence of isolated perpetual motion vortices, our author repudiates Lord Kelvin's conception of an ether vortex ring atom, and adopts instead a modification and expansion of Maxwell's theory In presenting those conceptions of motion on which his conclusions as to the constitution of the ether are based, Mr Erwin resorts to many ingenious and simple analogies and devices, and one great merit of his work is its care in keeping the discussion within the understanding of the ordinary educated intellect In so far as the work deals with matter, it faithfully reflects the leading thought of the day; its views upon the constitution of the ether are stimulating and in the highest degree worthy of a hearing their confirmation or refutation must rest with a future race and a more advanced science

RAILROAD VALUATION AND RATES. By Mark Wymond. Chicago Wymond & Clark, 1916. 8vo., 344 pp. Price, $1.50.

In order to lead the reader up to a vantage point from which the field of railroad valuation and rates may be intelligently surveyed, the author wisely furnishes preliminary chapters on promotion, construction, and capitalization These correct popular misconceptions and make understandable the relationship between financing, construction, and rate-making. The treatise is unprejudiced and well-argued, and its teachings are buttressed by authentic tables of capitalization per mile operated, of operation expense and depreciation allowances, and of many other considerations which enter into this intricate subject, and which must be absorbed and digested before the [illegible] of problems and conditions [illegible] the accuracy of his conclusions.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

WAIST —W C HYNARD, 39 W 29th St., New York, N Y The waist has an elastic draw band secured to the back of the waist the band extending out through openings in the sides of the waist and being disposed at the outer side of the front of the waist and free therefrom so that while the back of the waist will be held down a predetermined waist line the waist front may be adjusted up or down along the waist line to conform with the figure, the sides of the waist being adjusted along an elastic draw band to accommodate the sides of the waist to the adjusted waist front

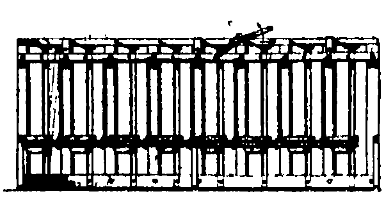
TROUSERS KNEE LIFTING DEVICE —S. ABRAMSON, 261 Bleecker St., New York, N Y This invention relates to a lifting device for each leg of a pair of trousers for the purpose of automatically lifting the lower portions of the legs when the knees are bent, as in sitting down, ascending steps, stooping and the like, whereby the objectionable bagging of the trousers legs at the knees is positively prevented and movement of the legs is unimpeded

Electrical Devices

LEVEL —D W L. FRANK SR. 2024 W Harrison St., Chicago Ill This invention has reference to leveling instruments and aims primarily to provide a level of the illuminated vial type with means whereby the vial may be adjusted from time to time so as to always indicate the true and the correct reading

Of Interest to Farmers

FEED RACK FOR CALVES —M J HAGER, Denmark, Wis. This rack is for use particularly in feeding young calves in which a plurality of stanchions is provided having each associated therewith a drinking bowl, the bowls



FEED RACK FOR CALVES

being separated by partitions whereby the animals in feeding will be practically isolated from each other and thus prevented from interfering one with another in any manner while feeding

Of General Interest

ALUMINUM PLATING PROCESS —F MOENCH Rushville Ill The invention provides a process for plating aluminum with tin, lead zinc or alloys, of the same which may be carried on in an economical manner and with very simple apparatus provides a process of plating iron or other metals with aluminum and provides a process which may be carried out without the use of brushes or instruments for scratching or rubbing the aluminum

PROCESS OF RESTORING RUBBER.—F MOENCH Rushville, Ill In the present patent the invention has reference generally to processes for restoring old rubber, the object being the provision of a simple and inexpensive process by means of which new life may be imparted to rubber which has deteriorated from various causes

DISPLAY CARD —H L. KALISH, 78 80 Walker St., New York, N Y An object here is to provide a structure which effectually holds the displayed article in place Another object is to form a display card or sheet from a single strip of material bent so as to present overlapped edges, acting as pockets for the ends of the articles being displayed upon the card or sheet

THERMOMETER.—F S DICKINSON Rutherford, N J This invention improves and simplifies the construction of the carrying case or sheath and its relation to the thermometer with a view to insure an automatical centering of the thermometer when placed into the case to keep the bulb end of the thermometer spaced from out of contact with the closed end of the carrying case, and to permit the quick and convenient insertion in a removal from the carrying case without danger of breaking or otherwise injuring the thermometer

ENVELOP —W ZUCKERMAN, 2005 Belmont Ave, Bronx, New York N Y This improvement refers to mailing envelops, and provides an envelop which will afford an easy inspection of its contents by the postal authorities and which will prevent the contents thereof from falling out during the transportation of the same in the mail.

ROPE CLAMP —L. M. EVJEN, 708 E 137th St, New York, N Y The purpose in this case is to improve and simplify the construction and operation of a rope clamp so designed that a rope can be tightly clamped without danger of slipping, and at the same time the rope is capable of being easily disconnected.

Hardware and Tools

STAY BOLT —H. A. LACERDA, 308 Campbell Ave., Schenectady, N. Y The object here is to provide a stay bolt for the fire boxes of boilers and similar structures, which stay bolt is readily arranged to prevent leakage and undue straining of the boiler sheets by allowing

the belt to expand and contract, and to permit movement of the sheets in the direction of their plane without causing injury to the stay bolt.

COMBINATION MEASURING INSTRUMENT —W RODECK, 811 Madison St., New Durham, N J This invention provides an instrument for use in conjunction with an ordinary two-foot folding rule, and arranged to be used as an inside calliper or an outside calliper, or a hermaphrodite caliper, or a surface gage, or a scriber, and adapted for convenient attachment to a pocket to form a safety holder for the rule

SOLDERING IRON —F MOENCH, Rushville Ill An object here is to provide a soldering iron by means of which soldering operations that have hitherto been considered difficult may be readily accomplished A further object is to provide a soldering iron which is particularly adapted for soldering aluminum, and by the use of which aluminum soldering may be rendered easy

Household Utilities

SASH CORD ATTACHMENT.—P HEIN 444 East 79th St New York, N Y Among the objects of the invention is the provision of a novel anchoring means for the end of the cord to the window sash, such anchoring means being adapted to be put in place or changed without disturbing the window sash or frame surrounding it.

BISCUIT CUTTER.—W H. SCHEFFIUS, 308 West Southside Boulevard, Muskogee, Okla This improvement relates to biscuit cutters, and the main object thereof is to provide a utensil by means of which large numbers of circular or otherwise shaped portions may be quickly cut from a slab of dough, said utensil being used in the manner of a rolling pin.

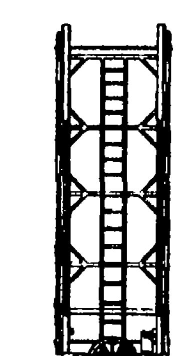
MEASURING ATTACHMENT FOR CAN COVERS —G T ENGLUND, Miami, Ariz. The invention provides a can closure with an extensible arm carrying a bowl dipper, or spoon, whereby measured quantities of the contents of the can may be taken out as needed the arm being in the form of a pair of telescoping sections capable of being collapsed in order that the cover may be put in position on its can

COMBINATION IRONING BOARD AND STEP LADDER —H HARRIED, 730 South Maple St, Spokane Wash This invention relates more particularly to an improved combined ironing board and step ladder and sleeve board It provides a board which may be adapted for use either as an ironing board or as a step ladder by merely shifting the board bodily from one position to another

Machines and Mechanical Devices

PRINTING PRESS —J E. RATHBUN, 8 Dutch St, New York, N Y This invention provides means for operating the inking carriage of a 'job' printing press to augment the dwell period in the operation of said carriage provides means for suspending the operation of said carriage and to avoid wear of the carriage operating connecting member and increases the out put of the press by increasing the speed of the operation thereof

MACHINE FOR LOWERING LUMBER.—J A PETERMAN, Franklin, La. This invention relates to machines for lowering lumber or other material from the tops of stacks or



MACHINE FOR LOWERING LUMBER

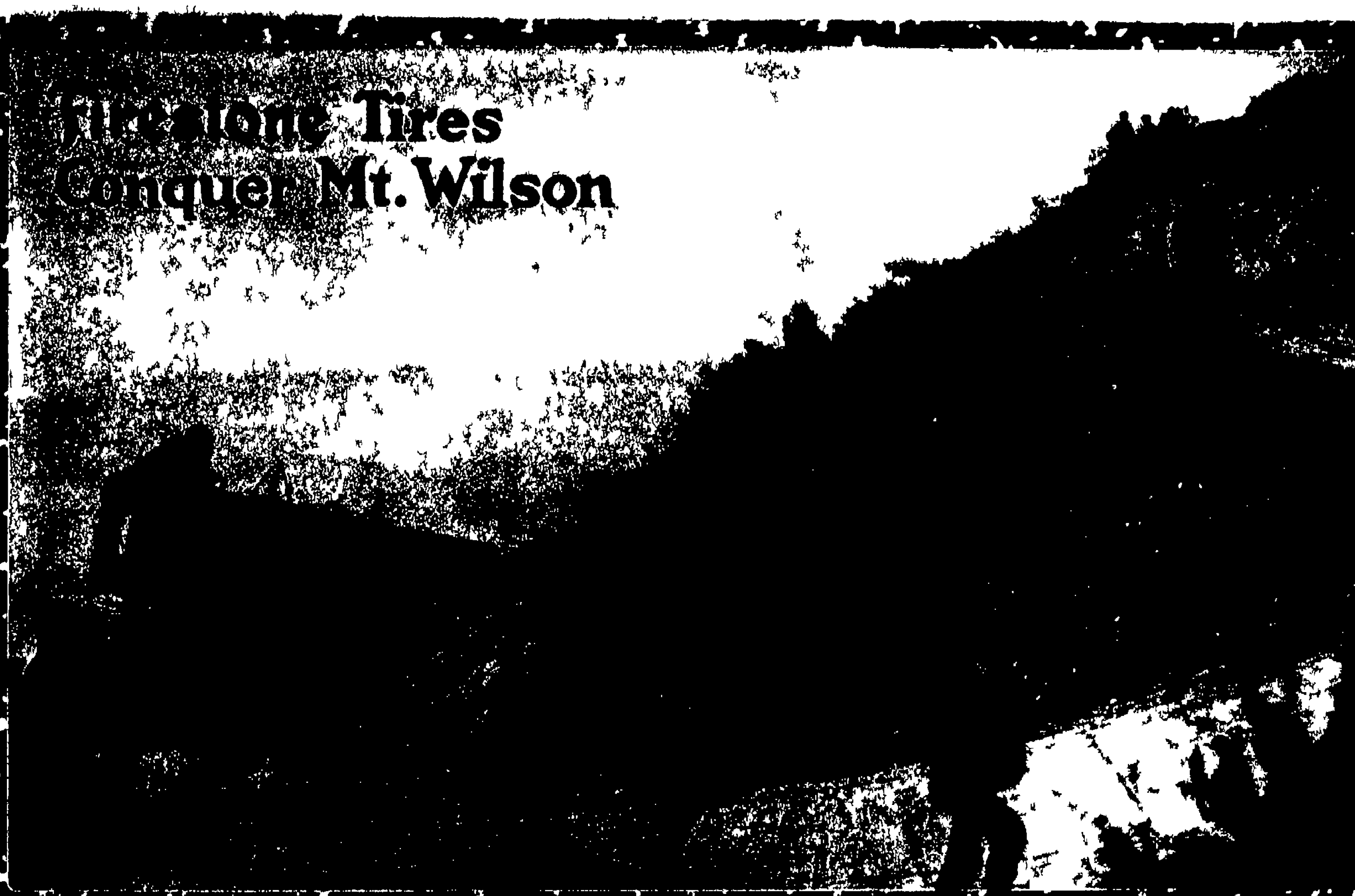
piles of the same It provides a portable machine which may be moved from one place to another in a lumber yard, and which is particularly adapted for use in lowering the lumber from the tops of stacks.

SAUSAGE MACHINE.—J C SMITH and S A DARNELL, care of A D Davis Packing Co, Inc., 105 South Royal St., Mobile, Ala. The invention provides a machine adapted for simultaneously operating upon a series of rolls of sausage, of that type known as "wienerwurst," or the like for dividing the several rolls into links of a predetermined length, by subjecting the roll at predetermined points to a twisting movement on its long axis, whereby to divide the roll into links.

Designs

DESIGN FOR A CARPET OR RUG.—J. G PROBL. Address G S. Squire, care of the Bigelow Hartford Carpet Co., 25 Madison Ave., New York, N Y In this ornamental design for a carpet or rug the border is composed of a heavy mass of beautifully connected leaves and flowers, and the center comprises attractive features in scroll and flower work.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



Pulling 13 Tons of Steel Up a Nine mile Mountain Trail Using the World's Toughest Tires to Build the World's Largest Telescope

–And Finish 100 Per Cent Good!

Almost without a scratch Firestone Tires came out of this tremendous trial! Nine miles of zig-zag climbing over a rocky trail where precipitous cliffs made skidding a fatal possibility. But the Firestones didn't skid.

Weight on Back Tires

The strain of the overhang was terrific—4 tons on the rear. In many places the weight of truck and girder (16¾ tons) rested wholly on rear tires—and all made worse by the gritty grind of granite

Send for illustrated folder with details of this interesting test It proves how ordinary work is easy for Firestone equipment

Firestone Trailer Tires—Extra tough and strong, all styles and sizes

Firestone Tire and Rubber Company

America's Largest Exclusive Tire and Rim Makers

Akron, Ohio—Branches and Dealers Everywhere

Firestone

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Cigarettes are the *mildest* form of smoking. That is why they appeal today to so many men of this type—men who force success by *clear thinking*.

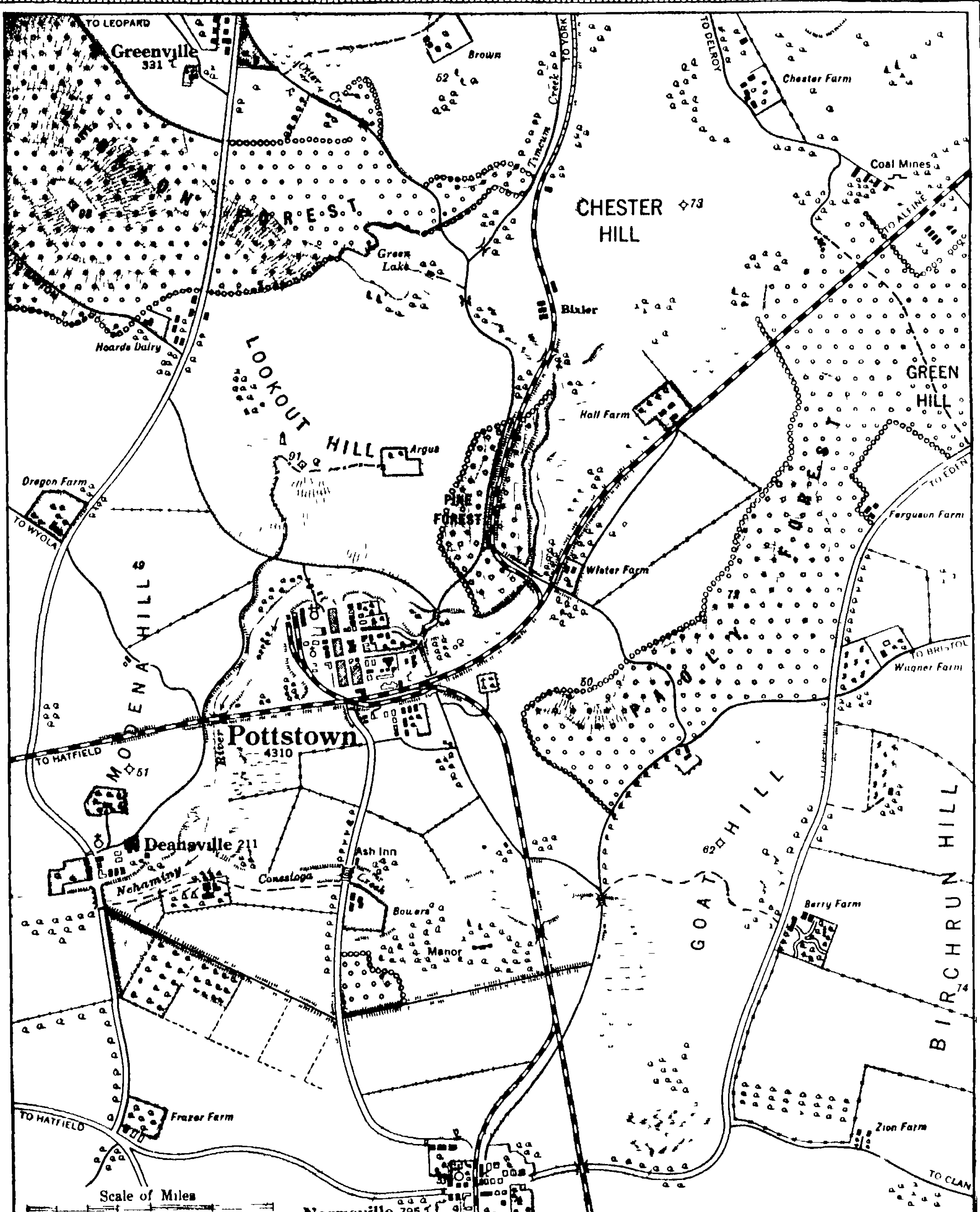
And because Fatimas are so truly a SENSIBLE cigarette, they are day by day becoming the chosen smoke of more and more men of this calibre.

Liggett & Myers Tobacco Co

FATIMA

A Sensible Cigarette

SCIENTIFIC AMERICAN



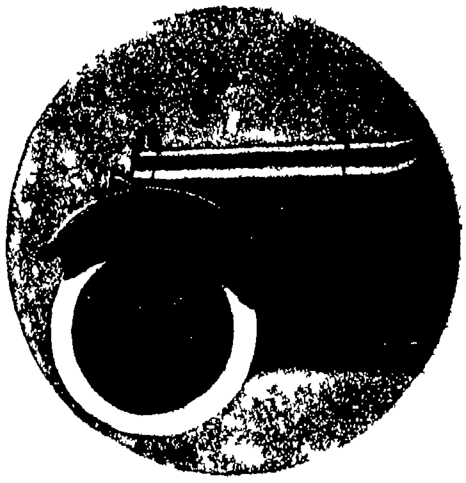
Map of the imaginary region in which the Scientific American War Game is being played.—(See Page 328)

March 25 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

Hupmobile



THE Hupmobile—with its clean, simple, powerful, four-cylinder motor—furnishes all the elements most desired in motor car performance:—

Rapidity of pick-up, flexibility, and pulling power on high gear, smoothness, silence, and absence of vibration at any speed

These characteristics, and its consistent economy, explain why old owners remain steadfastly loyal, and why the Hupmobile market is steadily widening among those seeking a quality car.

Let us prove that we are justified in our belief that "the Hupmobile is the best car of its class in the world."

Hupp Motor Car Corporation, Detroit, Mich.

Each purchaser of a Hupmobile receives without extra cost a book of coupons good for 50 hours of service labor on his car at any Hupmobile service station. Of these there are now approximately 3300 on main traveled roads and Hupmobile service is available in all parts of the United States and Canada

Five-passenger Touring Car	$1085	Two-passenger Roadster	$1085	Seven-passenger Touring Car $12[illegible]
Year-Round Touring Car	1185	Year-Round Coupe	1165	Prices F. O. B., Detroit

Courtesy First—Safety for Others in Motoring

The mark of superior H *motor car service*

SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV.] NUMBER 13 | NEW YORK, MARCH 25, 1916 | [10 CENTS A COPY $3.00 A YEAR

Our Vanishing Export Trade in the Products of American Forests

SINCE the days when the pioneer axeman went into the American forest to find resources whose natural advantages were not eclipsed in any land, the once great, and still important woodlands of the United States have been tapped repeatedly for use not only here but elsewhere in far corners of the world. The forests of America were very nearly everything in the beginning, and without them the settlers would have had far less with which to make their start, little in fact as they did have as such things are reckoned now. Not long following the discovery and adaptability of Colonial woods here, they began to make their way abroad in divers forms, slowly at first, but gathering headway as time went on.

By sled and crude plank road, in raft and drive, later by great lake tugs and barges, by logging spurs and standard gage, American lumber found its way down to the coast, and its merits spread. Abroad, some things especially contributed to this. Among the early English navies, already beginning to wrestle with others for the supremacy of the seas, our native oak had found, and kept, a quite important place, other kinds became well known there too, for as a sawmill man the American had antedated the Englishman by some generations, and the English forests no longer ranked as important producers of wood and timber. Elsewhere, in Europe, this new trade took hold. Following the Revolution in this country the returning Hessians took with them to Germany quantities of the white pine seeds produced by our trees here. These they planted with German skill, and the American white pine has been growing so long in the Fatherland that no doubt many of the people there mistake it for a native now.

As familiarity with American woods and trees progressed, the trade in them increased, and that in timber alone showed remarkable gain. Dividing into four periods the last half-century, the annual value of exported timber from 1865-1869 was only $1,451,607, that from 1870-1881, $3,794,097; 1882-1890, $6,181,414, and during the last, and fourth, period, the yearly value grew to $12,412,888. It practically doubled with each of the periods given, and this branch of the industry is only normal so far as the remainder is concerned. During the ten months preceding November, 1913, a thoroughly average period, there were sent to foreign countries from ports of the United States logs and round timbers, firewood, and hewn timbers, lumber, cross-ties, box shooks and other manufactures of wood worth in the aggregate [illegible]. This is a considerable total, and the figures are [illegible] only the value of [illegible] from the [illegible] [illegible]

been estimated that their export trade in normal times was fully 10 per cent of the whole, and to the labor and numerous allied interests dependent upon it abroad and here.

There they counted much upon their regular imports

A lumber vessel in port

The lumber business at Port Blakely, Washington, is largely carried on through ocean shipments. The stacks of rough material are ready for loading and sailing vessels still carry most of the coastwise cargoes.

of American woods and it was a well found trade. Freight rates by boat were very reasonable that from America to Europe being no more than for a few hundred miles by rail on land. The traveler for instance who visited the Netherlands and Rotterdam at the outlet of the Rhine could not fail to remark the piled up stocks of wood and timber. Some was used there but if the traveler journeyed up the Rhine to Germany he passed great steamer loads of this same lumber en route to Frankfort or perhaps Mannheim the German city that boasts the largest inland harbor in the world. There on the waterfront he saw again much of this same material, ready now for unloading and distributing to many parts of the Empire then to be returned to us after some months as novelties toys perhaps tanning materials extracts or whatever the cheap but skillful manufactories could produce there and sell here. It was a good trade and the lumber from America was paid for as soon as it had been loaded upon the great freighters on this side. Germany was in no sense the only great user either but she was typical.

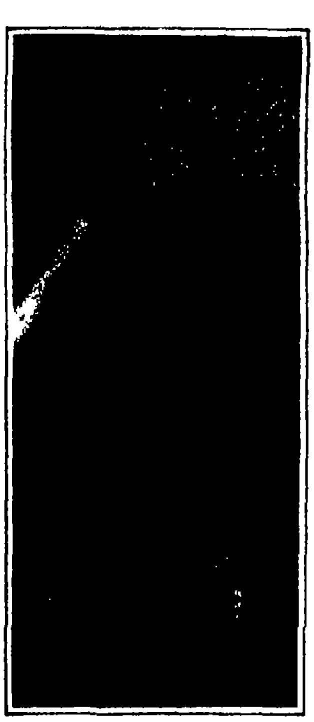
Two years have made a change. The extensive German trade which had been piling up for many years abruptly ceased not long after the commencement of the war. Reports of the foreign commerce of the United States in wood make no mention of Germany for the ten months to the 1st day of November 1915 and the trade with Belgium has also disappeared. True in England France and some of the other countries there still exists a slight demand. Black walnut not only good for gun stocks is also being used for aeroplane propellers while for white pine and spruce ash and hickory, there have been found some special uses. Such woods are being exported in long straight logs but trade in them represents an unfortunately small part of what our exports formerly were and the cheaper woods sold for such purposes as the construction of temporary army barracks at training and concentration camps has not enlarged the total greatly. The United Kingdom for example is receiving exports of wood worth about three quarters of what they normally should be. The United Kingdom it may be added makes a better showing than the rest.

Considered *in toto* the trade which two years since was quoted at $100 076 600 has been for the corresponding period of 1915 just $45 3.5 146—45 3 per cent of the former figure. For 1914 which was part peace and part war this trade was 68 8 per cent of we might say the normal. And while the reason for most of this is plain the same figures show unmistakably that we have not improved our trade with the countries of South America. It is impossible to say what the reading will be in 12 months more. With the resumption of "ordinary" times here and average conditions there, this export trade may regain its

(Concluded on page 334)

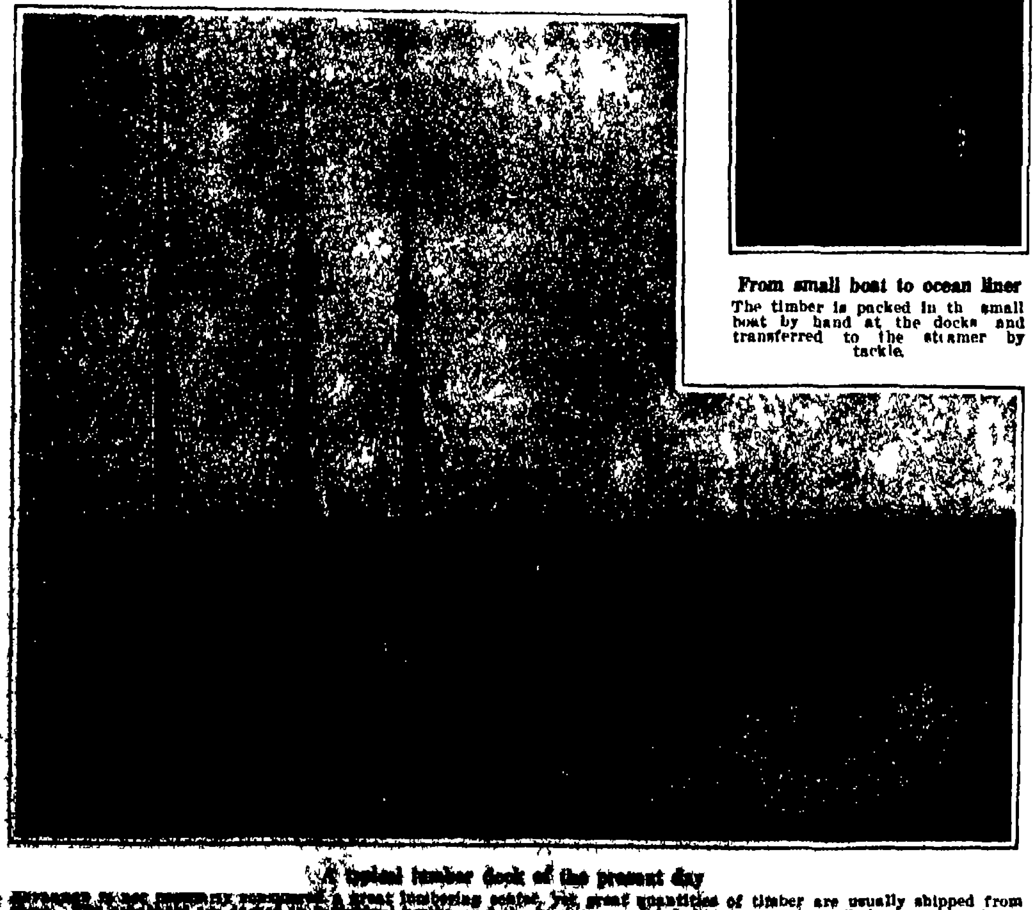
Crude methods of loading lumber in Central America

Rough hewn sticks of timber are taken beyond the breakers by men and oxen, and from there conveyed by small boats to the freighter. Primitive methods still prevail, and so far no better means of "stowing cargoes" has been discovered.



From small boat to ocean liner

The timber is packed in the small boat by hand at the docks and transferred to the steamer by tackle.



A typical lumber dock of the present day

[illegible] a great lumbering center, yet great quantities of timber are usually shipped from [illegible]. [illegible] are docked in [illegible] berths, and the lumber assembled here comes by rail from a very large territory inland.

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Industrial Preparedness for War

THE most practical and comprehensive work looking to preparedness against war is that being done by the Committee on Industrial Preparedness of the Naval Consulting Board. With the object of effecting a complete mobilization of such of the country's resources and manufacturing facilities as may lend themselves to the production of war material, the Committee is enlisting the services of the great engineering societies of the country, including the civil, mechanical, electrical and mining engineers' societies and the chemical society. As the result of this effort, some 30,000 highly educated and thoroughly expert men scattered throughout the length and breadth of the United States have undertaken the voluntary work of gathering and forwarding to the sub-committee complete statistical data regarding the industrial facilities and resources of the country. The assistance of the financial and business men of the country, moreover, has been assured through the hearty coöperation of that powerful institution, the United States Chamber of Commerce.

The plan of operation is to send to every one of these 30,000 engineers a tabulated form, broadly similar to those used in census taking, on which will be recorded the nature of the product or products turned out by the various manufacturing concerns, the number of employees, the size of the plants, and the character of their equipment, the facilities for transportation, both of the raw materials and the finished product, and a score of other facts bearing upon the question of the suitability of the various concerns investigated to turn out munitions or other military supplies.

Although the details of the working plan which will be based upon the statistics thus gathered have not been finally determined, the broad idea will be to place with each of the concerns included in the mobilization a yearly order for a small amount of those army and navy supplies, for the furnishing of which in war time, on a large scale, the plant is suitable. These small orders will be filled under the standard specifications of the government.

The manufacturers selected will thus gain experience in turning out supplies that are subjected to the regular government tests, they will become familiar with government procedure, and they will ultimately be in a position to start upon the large emergency orders which would be received upon the outbreak of war. The work will be done on a cost plus a reasonable profit basis, and thus the war for profit cry of the pacifist will be smothered!

Modern war is machine-made. More than ever before and far more, even, than the experts had imagined, science and machinery have proved to be the dominating elements on the battlefields of to-day. The possession by a country, such as ours, of scores of thousands of machine shops and millions of skilled mechanics is no guarantee that it can go to war successfully at a week's notice. On the contrary, the sad experience of many of the American firms which accepted foreign orders for munitions at apparently very favorable and lucrative prices, has proved to our engineers that the manufacture of war material is an exceedingly specialized branch of the engineering arts, calling for the provision of special tools and appliances before the manufacture of a shell or a rifle can be even commenced. In proof of this, consider, for instance, the fact that the millions of rifles ordered from this country must be made in all their parts to the thousandths of an inch and pass the searching test of specially fine gages—the mere bolt mechanism of the rifle alone having to pass the test of over 160 gage measurements. It was found, when the huge foreign war orders were being placed in this country, that there were only three firms engaged in the manufacture of such gages as were necessary; and it was estimated that, if dependence had been placed on these firms alone, it would have taken years of time and millions of money merely to provide the gages necessary before manufacture could be undertaken.

The story of the delay in the delivery of war orders to the Allies from this country affords eloquent testimony to our state of unpreparedness. So much time has been lost in the preliminary work of getting ready to manufacture, that we are authoritatively informed that not a single shell out of the millions that have been contracted for has yet been fired from a French gun.

The German Fleet in the North Sea

THAT the German main fleet has lately passed out from the shelter of Helgoland and has been maneuvering in full strength in the easterly half of the North Sea seems to be pretty well established by the cable dispatches from Great Britain and the neutral countries. A considerable portion of the British press is disposed to interpret these movements as an indication that the German Admiralty, after nineteen months of preparation is about to put the supremacy of the British Navy to the test in a great general engagement.

There is every reason to believe that 1916 will be the decisive year of the war, and that the great attack on Verdun will prove to be the forerunner of a series of violent offensives by the Central Powers, which realize that they have now reached the maximum of their fighting strength and, if they are to win the war, must do so in the coming months, or never. Some of the British naval critics believe that the great German effort on land will be matched by a stupendous battle on the high seas, in which Germany will stake everything on an effort to crush the British fleet or cripple it so seriously that its stranglehold on the throat of the Central Powers will be broken for the rest of the war.

Judged by the strength of the respective fleets in dreadnoughts, such an attack, if it be made, must seem to all impartial critics to be in the nature of a forlorn hope, for if all the battleships and battle-cruisers that were authorized by the two nations when the war began have been completed, Great Britain now has 48 dreadnoughts against Germany's 24. And it must be remembered that this preponderance of 100 per cent in mere numbers does not represent the full advantage enjoyed by the British, for none of the 48 battleships carries a gun of less than 12 inch calibre and 32 of them mount guns of 13.5-inch or 15-inch calibre, whereas, 11 of the German ships mount nothing heavier than an 11 inch gun, 13 of them mount a 12-inch gun and 3 of them, only, mount a 15-inch, or, if recent reports from Germany be correct, a 17 inch gun. In speed also the British have a marked advantage, their battleships running from 21 to 25 knots (this latter in the case of the five Queen Elizabeths) as against speeds of 19½ to 23 knots of the German battleships. Furthermore, the British can oppose 10 battle-cruisers of from 25 to 30 knots speed against 7 battle-cruisers of from 25 to 29 knots speed.

On paper, then, the superiority of the British fleet is overwhelming, and it is this fact which has led to a growing conviction, at least among the lay public, that the German navy "has something up its sleeve," and that when the rival forces are engaged, it will be found that German ingenuity will uncover some totally new, unexpected, and overwhelming enginery of sea warfare, which will be sufficient to turn the tide of battle to her favor. These speculations take the form of a belief: first, that the German fleet has been rearmed (as the German press has frequently stated) with 17 inch guns, and with howitzers comparable in size and destructive energy to the 16½ inch German howitzer, which stole the credit for the reduction of Liege, Namur and Mauberge from the Austrian 12-inch Skodas; second, that the German submarine fleet has been augmented by an unsuspectedly large addition of new submarines of unusual power and speed; and thirdly, that the skill of the German chemists has furnished the navy with huge smoke- and gas-producing shells, with which they will break up the British battle-line as effectually as they cleared the trenches in the first poison gas attack of the war.

With regard to the rumor that the German fleet, or indeed any portion of it whatsoever, has been rearmed during the war with the 17-inch gun, let it be understood that such rearming is, in the very nature of things, impossible. So great would be the size and weight of a 17-inch gun that the existing turrets, barbettes, gun carriages, ammunition hoists, magazines, etc., would have to be taken out of the ship and entirely new structures, far more massive, occupying much greater space, and of considerably greater weight would have to be built into the ship. Probably the hull itself would have to be strengthened to withstand the additional stresses imposed; and by the time the job was completed it would be found that it would have been cheaper and far more effective to have built an entirely new ship. If any 17-inch naval guns have been mounted it has been in the three latest ships of the "Frederick III" class, which, when the war opened, [illegible]

[illegible] to [illegible] of [illegible] on shore, would be [illegible] the howitzers were fired from the [illegible] of a ship at sea.

As to the ability of the Germans [illegible] naval tactics by the introduction of smoke and gas-bombs we have our doubts. True it is that photographs taken from an English cruiser have been published showing, or purporting to show, in the distance and lying low on the water, a dense bank of [illegible] clouds produced in this way; but we doubt if, during a line-of-battle engagement, sufficient streams of shells could be poured at an enemy moving at 18 to 20 knots seriously to interfere with his vision. The destroyer smoke-attack, first developed in our navy and used by the Germans in the North Sea fight, is far more effective than any practicable number of smoke-bombs could be, and if the Germans make use of the smoke screen they will do it by that means.

If the German Admiralty has anything "up its sleeve" it probably will have to do with its mining and submarine offensive. The very serious nature of the secret mine planting from submarines which Germany is now practicing, seems not to have been generally appreciated, and this form of attack, impossible of immediate detection as it is, might be used to deadly effect in the strategy and tactics of the great North Sea fight—should it ever take place. We are still of the opinion moreover that before the German fleet comes out to battle, its Admiralty will call home and assemble in the North Sea the whole of the German submarine fleet, and probably on the great day of trial the Germans will plant floating mines where the water is too deep for anchorage, and fields of anchored mines in shoal water such as obtains on the Dogger Bank, and that she will assign groups of submarines to assemble at certain definite stations in the North Sea. The main fleet, if it fails to attract the British to the mined waters off the German coast, will probably steam boldly to the English coast, draw the British fleet out, and then itself make a running fight of it to the eastward, endeavoring to draw the British fleet over the mine fields or into one or other of the waiting submarine flotillas.

The Rise of the Bureau of Standards

THE activities of the United States Bureau of Standards have now ramified so far, in a geographical sense, that the name of the institution is probably familiar to every reader of this journal; yet so rapid has been its rise that the majority of the population certainly does not realize the immense and ever expanding scope of its work. The name of the bureau is not illuminating in this respect until one learns that the "standards" with which it is concerned include standards of measurement, standard values of constants, standards of quality, standards of mechanical performance, and standards of practice. Hence it is very far indeed from being merely a "bureau of weights and measures." In fact, it combines functions that are, in most countries, entrusted to more than one official establishment.

The last annual report of the Bureau of Standards, reviewing its operations during the fiscal year 1915, is more than impressive—it is bewildering. A mere enumeration of the various lines of inquiry and service upon which the institution has embarked would fill several columns of this journal. From gauging the speed of photographic shutters to developing apparatus for measuring the heat of the stars; from testing twine to studying the effects of sea water on concrete; there is hardly a branch of industry in which the bureau has not taken a hand.

All this is magnificent; but it is also puzzling, when one considers that the total annual appropriation for the bureau is less than $750,000. Apart from the director, at $6,000 a year, and two chief assistants at $[illegible] each, the experts of the institution do not receive such salaries as would discourage private establishments from bidding for their services. Lastly, even if, by some miracle, the bureau were able to attract and retain the very best technical talent of the country, the mere numerical strength of the staff would tend to impose a limit to its versatility.

Is the Bureau of Standards [illegible]? We hasten to say that if such is the case [illegible] not insist that [illegible] [illegible]

Automobile Notes

Fire Dangers.—Most everyone who has had any dealings with machinery knows about the liability of oily rags and waste that have been used for cleaning purposes to ignite from spontaneous combustion, but few are aware that sawdust, when soaked with oil drippings, will act in the same way. Sawdust is sometimes seen scattered over garage floors, but this practice should be prohibited. Sand is the safest for absorbing drippings.

Some Causes of Accidents.—It has been frequently noted that accidents seldom happen when the driver is riding alone, and the inference is drawn that when he has passengers he "visits" with them, thus having his attention diverted from his duties in guiding and controlling the machine. There is still another situation that has not been mentioned, and that is the petty minded man who wants to "show off," or worse still, who thinks it funny to frighten his passengers by taking risks that he would not think of doing when alone. Such cases are but too common, and it is a pity that there is not a psychologic recorder that will expose such people and lead to a revocation of their licenses.

Are Cars Too Complicated?—Almost every new model that is brought out has some new attachment or fitting intended to promote the convenience of operating, but the question arises whether our cars are not becoming too complicated for the average user. Even where a professional driver is employed it can hardly be expected that he can be an expert in the many different directions necessary to proper adjustment and repair of the car of to-day. The bicycle is about as simple a piece of mechanism as can be conceived, but in their day a favorite claim of some makers was that they were "fool proof." It was not a particularly tactful expression, but if such construction was necessary then, how much more desirable now.

Alloy Pistons.—Much attention is being given to aluminum alloy pistons, and although they have been under investigation for some years, the user generally supposes that their value lies in their light weight. This is not the case, for, as a rule, little is gained in this direction. These alloys are so soft that it is necessary to fit larger wrist pins in order to secure them properly from coming loose, and to put in considerable metal to hold these pins, so that the resulting piston is little lighter than a good steel piston. There is, however, an advantage in using these alloys, for they are approximately three times better conductors of heat than cast iron or steel, and this is an advantage worth having, as the heads keep cooler than cast iron, and less carbon is produced. Also, owing to the metal being softer, there is less liability of such a piston seizing, and little injury results if it does. They also wear well in a cast iron cylinder.

Dimming Lights.—California has made a law requiring headlights to be permanently dimmed on state or public highways, and prescribes that the center rays must not strike the ground further than seventy five feet in front of the automobile. A correspondent of that state tells how he has arranged his lights, as follows. The lower part of the headlight is covered with "lamp frosting" up to the level of the center of the electric globe, and this cuts out the rays that shine upward, and only permits the free passage of the downwardly directed rays from the upper half of the reflector. The lamp must be properly focussed, and the lamp itself is tilted slightly downward if necessary. This arrangement gives the full power of the light on the road, but does not dazzle approaching drivers. This method of dimming is directly contrary to the usual practice, in which the upper half of the lamp glass is frosted, but it obviates excessive tilting of the lamp, and the results are stated to be superior.

Automobile Accident Records.—According to the best statistics, the number of automobiles in the United States increased from 200,000 in 1909 to 1,750,000 at the end of 1914. The number of deaths attributable to automobiles rose in the same period from 632 to 2,623, or an increase of 775 per cent. However, statistics indicate that the proportion of fatal accidents to the number of automobiles is decreasing, indicating that the drivers of automobiles are becoming more skilful and more careful. Of these fatalities a noticeable proportion occur at railway crossings, and for these the victims can only blame themselves, for the necessities of the majority of automobilists are not so pressing but that they can spare enough time at a railroad crossing to insure their own safety. The majority of other accidents occur in cities, and there is no question but too many city drivers attempt to maintain too high speeds. Undoubtedly the walking public is extremely careless—even stupid; but this does not free the automobilist from the obligation to drive his heavy car with caution, especially when it is considered that a speed that would insure freedom from accidents only amounts to the loss of a very few minutes in a day.

Astronomy

Observations on Mars at the Lowell Observatory during the present opposition show that the canal development strikingly corroborates the theory of seasonal dependence on the melting of the polar cap. The northern canals are now very dark, indicating increased activity with advancing spring, while the southern canals are faint in their autumnal decline. The season in the northern hemisphere of Mars is now late April.

Recent Observations of Saturn at the Lowell Observatory show a remarkable change in the color and brightness of the planet's ball, which is now of a pinkish brown tint and strikingly darker than the rings. Comparisons of the stellar magnitude of the planet with Capella, Procyon and Mars also show that its brightness is less than that predicted in the ephemeris.

Progress of the 100-Inch Telescope.—Director Hale, of the Mt. Wilson Observatory, reports in a recent note that at the close of the 1915 construction season the steel dome for the 100-inch reflector—the world's largest telescope—was completely inclosed and in working order. The shipment of the tube constructed at the Fore River Ship Yards, has been delayed by the suspension of traffic via the Panama Canal. The parabolizing of the 100-inch mirror is now 85 per cent complete. It is not now thought that the great telescope can be ready for use before the summer of 1917.

Dark Celestial Objects and their Luminous Background.—Prof. E. E. Barnard has recently called attention to the discovery of many dark objects on the photographs taken with the Bruce telescope of the Yerkes Observatory, often in regions of the sky where there is no ordinary nebulosity and where the stars are too few to form a luminous background for their relief. The appearance of these objects in black relief on the plates can perhaps be explained on the assumption that space itself possesses a feeble luminosity sufficient to affect the sensitive photographic plate with very long exposures. Similar dark objects are also seen in relief against a nebulous or stellar background.

Synchronous Solar and Planetary Phenomena.—Periodicities in various meteorological and magnetic phenomena on the earth have been more or less conclusively linked up with the sunspot period and other periods of solar activity, hence it is natural to look for analogous correspondences between the phenomena of the sun and of other planets than our own. In this connection *Nature* cites some recent researches by T. Köhl, who finds that Jupiter's northern cloud belts appear to be especially weak at times of sunspot maxima and to become broader and more conspicuous during sunspot minima. Observations of the "secondary light" on the dark side of Venus suggest coincidence in time with auroral displays on earth, and the latter, of course, coincide with periods of solar activity.

Meteor Campaign.—In the SCIENTIFIC AMERICAN, of July 10th, 1915, announcement was made of a meteor campaign in which amateur astronomers were invited to take part. The object was to make an exhaustive study of meteor trails in order to connect them, if possible, with the orbits of lost comets. Prof. S. A. Mitchell, of the Leander McCormick Observatory, reports that the campaign has been very successful. The total number of observations sent in, up to the beginning of January amount to no less than 4,644. This makes the largest piece of systematic work ever done on meteors in this country. From the observations sent in there are sufficient data for the formation of about 120 parabolic orbits, which, of course, give the paths of the meteors. The work is still proceeding and an invitation is extended to all who are interested in the subject, to write to the Leander McCormick Observatory, University, Va., for instructions.

Fluctuations in Solar Radiation.—The researches of Dr. C. G. Abbot and his colleagues show that short-period fluctuations of solar radiation were relatively large in 1913 and small in 1914. In the former year the values of the solar "constant" ranged over nearly 10 per cent, between the extreme limits of 1.81 and 1.99 calories, though the range was seldom more than 3 per cent in any ten-day interval. In 1914 the extreme range was only 4 per cent, between the limits 1.91 and 1.99 calories. Associated with these short-period fluctuations are found variations in the contrast of brightness between the center and edges of the solar disk. Strange to say, while greater contrast is associated with greater solar radiation and with numerous sunspots in the general march of the sun's activity, lesser contrast is associated with greater solar radiation in the march of the quick, irregular fluctuations of the sun's emission. "This paradox," says Dr. Abbot, "points to two causes of solar variation, the long-period changes may probably be caused by changes of the sun's effective temperature attending the march of solar activity; the quick fluctuations may be ascribed to changes in the transparency of the outer envelopes."

Electricity

Electric Lamps Burn for Thirteen Years.—While refurnishing the City Opera House at Waterville, Me., several carbon filament incandescent lamps were found still giving service. These lamps continues the *Electrical World*, have been in use almost every evening for 13 years.

Sea Water and Electricity as Disinfectant.—By the electrolysis of salt water there is being produced aboard the British hospital ship "Aquitania" a powerful disinfectant in the form of a solution containing sodium hypochlorite, or available chlorine. The process is not new, but its present application is somewhat of a novelty.

Nitrogen-Filled Lamps Replace Arcs.—One by one the leading cities of the United States and Canada are gradually replacing the ordinary arc lamps with the new gas or nitrogen filled lamps. Not only do the latter type lamps eliminate the necessity of trimming the carbons, but they effect a saving which in some instances is reported to be about 35 per cent.

Electricity Reduces Mine Costs.—The Montana State mine inspector, in his annual report to the Governor, W. B. Oser, states in part: "By installing electric power in nearly every mining camp of importance in Montana, it has been made possible for operators to resume work on properties which otherwise would have been idle. This has done more to reduce the cost of mining than any other thing."

Longest Telephone Circuit in the World.—On February 14th the Bell Telephone Company successfully opened the Montreal-Vancouver telephone line. The line is 4,227 miles long as compared to the 3,400 miles of the New York-San Francisco line. The Montreal-Vancouver line does not run direct through Canada but instead for the greater part passes through the United States, touching the following connecting points: Buffalo, Chicago, Omaha, Salt Lake City, and Portland, Ore.

Cleaning Metals Electrically.—Although the electrolytic process of cleaning metals is comparatively new, it has recently been introduced by many large manufacturing concerns because of its efficacy and cheapness. The baths used are usually composed of alkaline substances such as sodium carbonate or potassium carbonate with small portions of potassium cyanide. It is said that with a current of from four to eight volts there is developed in such solutions sufficient hydrogen to remove organic substances from the metals, leaving them chemically clean.

Magnetic Hand for Crippled Germans.—There has been devised in Germany a magnetic hand which will enable those who have been crippled in the war to work at their ante bellum occupations. Briefly, the magnetic hand consists of an electromagnet held by two universal joints to a sleeve which fits over, and is strapped to, the wearer's stump. Current can be turned on and off at will so as to energize the electromagnet when desired. Since the hand can only be used in connection with objects which are attracted by magnetic influence tools such as wooden planes have been fitted with small plates of iron so as to respond to the magnetic pull.

Temperatures of Gas-Filled Tungsten Lamp.—S. E. Doane, chief engineer for the National Lamp Works at Nela Park, Cleveland, Ohio, speaking before the Western Association of Electrical Inspectors recently said that the measurement of the temperature of gas filled lamps is attended by many difficulties, on account of the fact that the light rays are intercepted by the thermometer used and upon their interception are transformed into heat. Careful tests have revealed that the temperature attained by the lamps is in the neighborhood of 150 deg. F., and that the base of the lamps becomes hotter than is the case with the former tungsten lamps. However, it is reported that the sockets and connecting wires are not seriously affected by the increased temperature.

Study of Rail Joints and Bonds.—The Bureau of Standards has recently published an interesting paper entitled "Modern practice in the construction and maintenance of rail joints and bonds in electric railways." The paper is largely a compilation of information in the nature of data and opinions submitted by 42 electric railway concerns which answer inquiries sent out by the Bureau. Analysis of the data shows that soldered bonds have been demonstrated to be unsuccessful and are now practically obsolete, while all other types of standard bonds are capable of giving good results, but only when carefully installed. Loose rail joints are shown to be the most prevalent cause of bond failures, and as a result there appears to be a marked tendency toward the adoption of improved methods and materials in their construction. The adoption of various types of welded joints to take the place of the common bolted joint appears to be in progress in most of the larger cities.

By courtesy of the New York Railroad Club

Locomotive that burns pulverized coal, thereby effecting a saving of 15 to 25 per cent of fuel

A Coal-Dust Locomotive

By Herbert T Walker

THE expenditure for locomotive fuel on our steam railroads amounts to nearly 25 per cent of the total cost of conducting transportation This enormous item of expense, coupled with the ever increasing cost of all material, due to the high price of labor, presents a problem which has engaged the attention of locomotive engineers for a number of years.

Experiments made in the way of burning solid fuel other than on grates in cement kilns and metallurgical furnaces have been successful, and pulverized coal is now extensively used for such purposes, but the difficulties inseparable from the conditions under which a locomotive has to be operated are great, and it is only recently that appliances for burning powdered fuel in locomotive fire-boxes have been practically developed

A paper on the subject was presented at a meeting of the New York Railroad Club recently, and by the courtesy of the club we are now able to give some particulars of this important step in railroad fuel economy

In the first place, it may be stated that any solid fuel which in a dry pulverized form has two thirds of its content combustible will be suitable for steam generating purposes Therefore, the low value coal mine and strip-pit products, such as dust, sweepings, culm, slack and screenings, and even lignite and peat, are as suitable as the larger sizes and better grades of coal As some of the products above named are now unsalable, the great saving effected by the use of the new form of fuel will be apparent, for the total cost to prepare pulverized coal in a properly equipped plant will be something less than 25 cents per ton This item will be more than offset by the great difference in the cost of the grades of coal purchased for pulverizing as compared with those that would be required for burning satisfactorily on grates

The preparation of the fuel is not complicated It must be thoroughly dry, that is to say the moisture should not exceed one per cent, and ground to a fineness so that it will pass through a screen from number 100 to number 200 mesh

The first locomotive of any considerable size to be fitted up in the United States or Canada (and so far as known in the world) with successful apparatus for burning pulverized fuel in suspension was a 10 wheel type of engine on the New York Central Railroad This engine has cylinders 22 inches diameter by 26 inches stroke Driving wheels, 69 inches diameter Boiler pressure, 200 lbs. Heating surface, 2,649 square feet. Grate area, 55 square feet. It is equipped with a Schmidt superheater and has a tractive effort of 31,000 pounds. It was converted into a pulverized fuel burner in the early part of 1914. Since then other installations have been made to a Chicago and North Western Railway ' Atlantic " type of engine, and to a new ' Consolidation ' type of locomotive for the Delaware and Hudson Company, which latter is probably the largest of its type in the world, its tractive effort being about 63 000 pounds

To give the reader an idea of the pulverized fuel burning equipment as applied to a locomotive engine we present an illustration showing the general arrangement partly in section The prepared fuel is passed into the fuel container 1 (which is a part of the ordinary locomotive tender) through the openings 2, 2. These openings are then tightly closed to keep out moisture, as dryness of the fuel is the prime requisite. To start the fire, the first thing the fireman does is to turn on the steam blower, 27, in the smoke box, then he places a piece of lighted oily waste in the furnace, 24 after which he starts the motor, 17, driving the fuel conveyor, 3, and then the motor, 14, which drives the air blower 18. The screw conveyor, 3, forces the fuel into the fuel and pressure air feeder, 4, where it meets the air driven by the blower, 18, through conduits 16. The fuel and air are thus driven through a commingler, 5, conduits 6 and 7, nozzle 8 and fuel and air mixer 9 This mixture then enters the combustion furnace 24, which is the ordinary locomotive fire-box provided with a fire-brick floor in place of grate bars, and is there ignited by the lighted cotton waste The fire-box is fitted with brick arches, 21 and 22, and auxiliary air inlets, 23. There are also induced air inlets, 11, to secure perfect combustion and a slag pan, 25, in place of the usual ash pan.

The air and fuel control regulators, 12 and 18, are in the cab within reach of the fireman, who has no need to go into the tender but can keep his place in the cab and assist the engine driver in looking ahead for signals The fireman's duties will be very light compared with his work required in hand firing coarse coal on the ordinary grates. This is easily understood when we recall that the fireman of a heavy modern locomotive has to shovel coal into the fire-box at the rate of about 6,000 pounds an hour, or 100 pounds per minute. This laborious work cannot be done with the care necessary to secure good combustion, with the result that quantities of coal are dropped into the ash pan, the flues are rapidly choked with soot, and clouds of smoke, unburnt coal and sparks are ejected from the stack, to the annoyance of passengers and danger to property adjacent to the railway

The improved system will change all this, for even when the fuel contains 15 per cent of non-combustible matter only about 2.5 per cent is deposited in the slag or ash pan, and this deposit is non-combustible. Whereas, when coal is burned on grates about 15 per cent goes into the ash pan, and this residuum always contains more or less combustible matter The saving in ash pan waste alone is an important item.

When the proportion of powdered coal and air is properly regulated, the mixture bursts into a clear, intense flame in the fire-box, having a temperature of from 2,500 to 2,900 deg. Fahr., with no visible smoke at the stack (except when the fire is first started) and making but little soot deposit in the tubes. With this system of easy and rapid control of the fire it takes less than 60 minutes to get up 200 pounds of steam pressure from boiler water at 40 deg. Fahr. When the engine is standing the fire may be put out entirely, and within an hour can be reignited from the heat of the brick arches in the fire-box.

Only one set of fuel and pressure air feeders could be shown in our illustration, but as many as five units may be placed in the ordinary tender As each unit has a capacity of from 500 to 4,000 pounds of pulverized fuel per hour, there will be no difficulty in meeting the requirements of the largest locomotives.

It is stated that the use of pulverized fuel effects a saving of from 15 to 25 per cent in coal of equivalent heat value delivered, as compared with the hand firing of coarse coal on grates

In conclusion it must be noted that there is a certain element of danger in the handling of pulverized coal that does not obtain with the more ineffective coarse coal But, with ordinary care and the observance of certain established rules, it is comparatively easy to avoid trouble, as is shown by the records of industrial plants using pulverized fuel

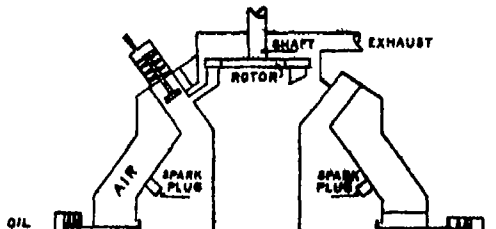
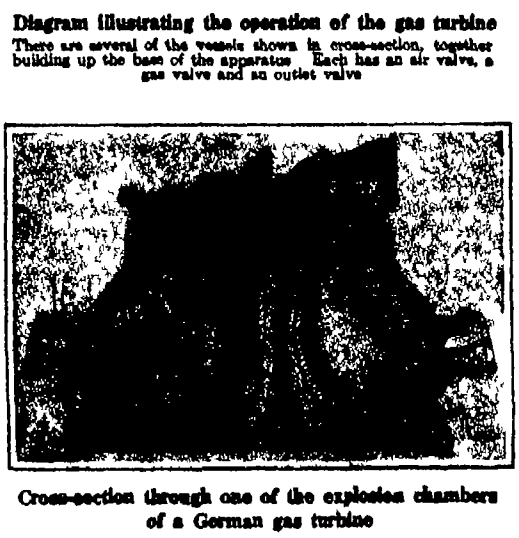


Diagram illustrating the operation of the gas turbine

There are several of the vessels shown in cross-section, together building up the base of the apparatus Each has an air valve, a gas valve and an outlet valve



Cross-section through one of the explosion chambers of a German gas turbine

An Ingenious Gas Turbine Developed in Germany

By Sydney F. Walker

WHAT appears to be a thoroughly practicable gas turbine was worked out in Germany just before the war A turbine furnishing about 200 horse-power was built at Hanover a few years back, and was run for three years in order that its faults might be observed. Later on, a turbine furnishing 1,000 horse-power and driving an electric generator was built at another works in Germany It was tested and an over-all efficiency of 20 per cent was claimed between the energy delivered by the explosions and the electricity furnished by the generator The special feature of the apparatus was that the explosions took place in one set of chambers, and the expansions partly in the explosion chambers and partly in the space in which the rotor of the turbine was revolving.

The rotor of the turbine ran in a horizontal plane; a number of explosion chambers, ten in the 1000 horse-power apparatus, being arranged around its shaft. The explosion chambers were cast together with air and gas chambers, the whole forming approximately a truncated cone, the electric generator being placed at the apex of the cone. The gas and air chambers were kept full at definite pressures. Each explosion chamber was first filled with air up to the pressure in the air reservoir; the air supply was then cut off and gas forced in also under pressure, preferably by successive strokes of the gas pump, so that the gas would form layers in the explosion chamber.

(Continued on page [illegible])

A Typewriter That Copies With Its Own Eye

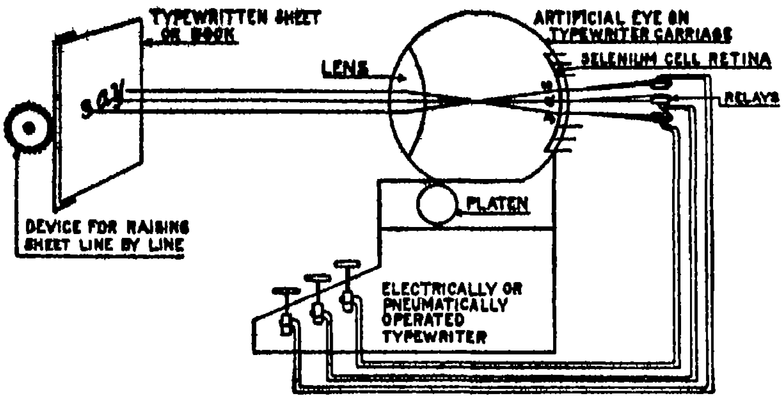
DESPITE the fact that the self-operated typewriter described in the following paragraphs has not as yet been actually constructed and tried out, not a little interest attaches to it for the suggestion it offers. Provided with a huge mechanical eye, this typewriter of the future will be capable of copying automatically any reading matter that may be placed in front of it.

The typewriter that copies with its own eye is the idea of J. B. Flower, an electrical engineer of Brooklyn whose name is not an unfamiliar one to the readers of this journal. The artificial eye is preferably attached to the carriage of the typewriter in order that it may move at the same rate of speed. It moves, step by step, over the line of printed or typewritten language appearing on a sheet of paper which is placed in front of the machine.

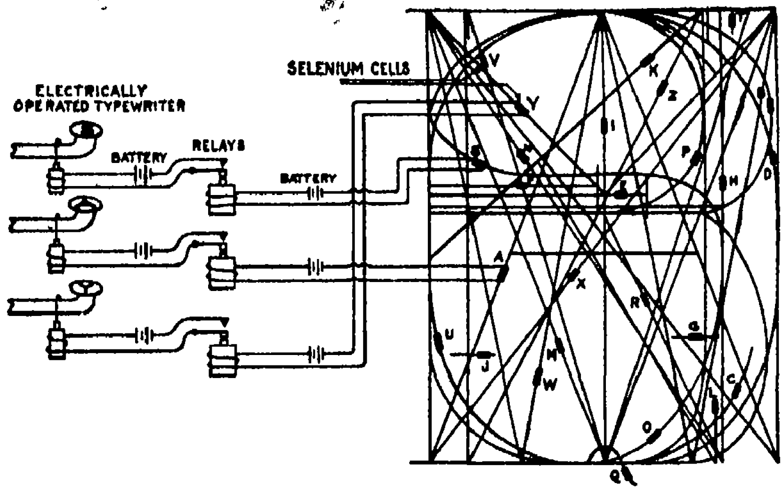
The artificial eye of the automatic typewriter must of necessity be of complicated construction. Essentially, it comprises a lens and a number of selenium cells arranged so as to form a retina similar to that of the human eye. The sheet of paper containing the copy to be duplicated is placed at a suitable distance from the artificial eye, so that a clear image of the letters will be produced on the multiple selenium cell retina. It is imperative that the eye move parallel to the read letters in order not to ruin the focus. The principle followed in connecting the selenium cells (low resistance cells) is that all the letters falling on the retina must be superimposed in one position, then the point or points in any one letter form which do not correspond to those of another letter form are the point or points which stand for that letter. These points can be connected to the typewriter for operating that particular letter form or character without chance of interfering.

The method of operating the new typewriter is to place the typewritten sheet or book of which it is desired to make a copy in a special stand or device for raising the sheet line by line. The sheet is now held in a vertical plane parallel to that of the selenium cell retina. For the sake of exposing the operation of the mechanism, it is assumed that the word being copied is "say." Upon starting the typewriter by turning on the electric current, the image of the letter "s" will appear on the selenium cell retina and its shadow will stand over the selenium cell marked *S* and no other, hence the current passing through it will decrease in amount allowing the relay armature to move, thus closing the local circuit and actuating an electromagnet which in turn operates the "s" typebar of the typewriter and prints the desired character on the paper. The carriage now automatically shifts the artificial eye over one letter space, with the result that the image of the letter "a" now appears on the selenium cell retina and its shadow stands over the selenium cell marked *A* and no other, thus causing the typing of the letter "a." Following the same procedure, the letter "y" is typewritten. For spacing, the typewriter is provided with a mechanism which, when the carriage moves over one letter space and no type key is operated, the space lever is brought into operation. Means are also provided for automatic line spacing, carriage return, paper insertion and removal, and other phases of typewriter operation.

As previously stated, the reading typewriter is based on the principle that when the standard letters of the alphabet are superposed one on top of the other, there will always be one point in each letter which is not com-mon to any other letter form. On typing the alphabet on the typewriter with all the letters superposed, it will seem at first that the statement just made is incorrect. The seeming difficulty however is not a real one but is due to the small scale of typing. If the typewritten letters are magnified 50 times so that they occupy 3 inches square each, and are then superposed, all of which can be accomplished by the artificial eye, it is found that the distinguishing points of each letter form are not covered; in fact they stand out beautifully individualistic as is indicated in one of the accompanying sketches.



Diagrammatic scheme of the main components and their relationship in the self-operated typewriter



Arrangement of the selenium cells which form the retina of the typewriter eye

The typewriter that writes what it sees with its own eye

THE READING TYPEWRITER

Unit Design in Marine Wireless Telegraphy

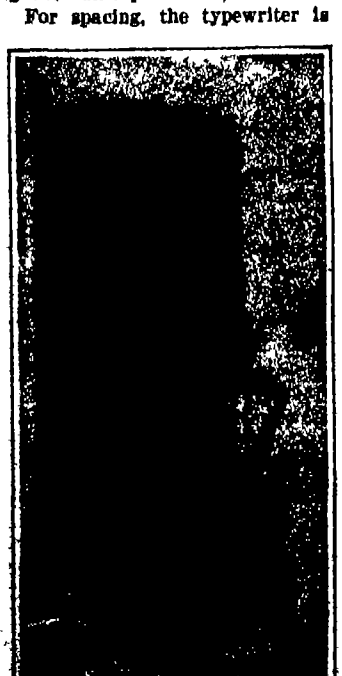
By J. Andrew White

THE transition of an art into a science invariably reflects a number of epochal steps which are widely heralded in the lay press; on the other hand, small notice is taken of developments which scientific workers recognize as those having the most important bearing on ultimate achievement. By way of illustration, radio communication, or the field of the wireless telegraph, has been marked by many brilliant feats of individual skill in annihilating space and setting up odd and startling uses for the ether wave energy, but little has been heard of concerted action among engineers toward the mechanical perfection which is found in the more matured arts. From the onlooker's viewpoint, standardization of wireless equipment has been a matter for the future to take care of, a step to be taken only with the perfection of individual apparatus. Communication over distances once incredible has so occupied the attention of the world that it is scarcely known that the past few months has seen the solution of many problems in marine working wherein the humanitarian values of the wireless telegraph have been so aptly illustrated in the past. The progress made in mechanical features is strikingly revealed in the announcement by an American wireless company that all its future equipments will conform to a standard design of the unit type, the complete transmitting apparatus being mounted on a single panel and the receiving equipment contained in a case of uniform design.

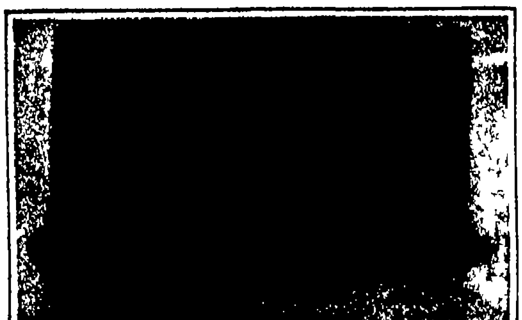
Aside from the interest aroused in the mechanical development revealed in this new equipment, the standardization feature opens up new possibilities in the acceleration of progress in the wireless art. Commercial operators will no longer have to master a number of types of installation, varying in arrangement, one might venture to say, with a frequency exactly proportionate to the number of ship transfers provided within the period of each individual's service at sea. Many of the staunchest vessels of to-day having been built at a time when wireless telegraphy and its legal status in maritime affairs did not have to be considered, no provision was made by ship designers for installation of apparatus or accommodations for operators. With widely varying conditions of space and location to contend with, the sets were installed principally according to the best judgment of the man assigned to the task. This objectionable condition is now obviously overcome with equipment of standard design available and uniformity of installation and method of operation may also be expected to furnish cumulative operating experience that will prove of great value in the solution of engineering problems and safeguarding of life at sea.

From the purely commercial side the new equipment possesses many advantages over its predecessors. The

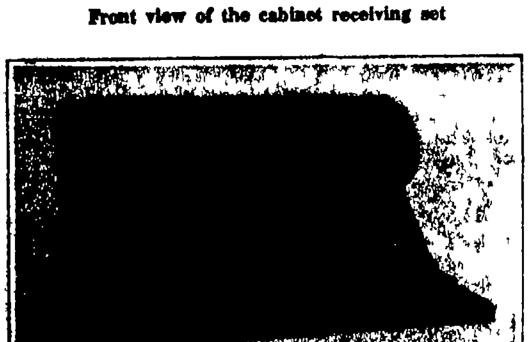
(Concluded on page 336)



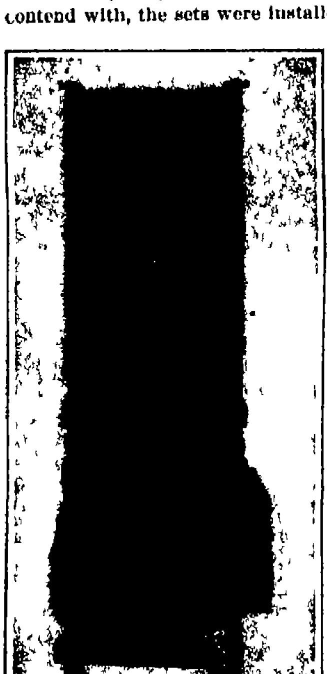
Rear view of the transmitter



Front view of the cabinet receiving set



Rear view of the cabinet receiving set



Front view of the transmitter

TRANSMITTER AND RECEIVING SET OF UNIT DESIGN FOR USE ON SHIPBOARD

Strategic Moves of the War, March 17th, 1916

By Our Military Expert

WHILE Spring, when the ground on all fronts will be in better condition than now for offensive footings, is in the offing the situation on the western battle line and principally about Verdun still challenges the particular attention of war observers

The German assaults have continued in violence under cover of and after preparation by the most tremendous artillery fire ever utilized in warfare There have been so far three distinct breaks in the offensive, probably necessitated by the wearing out of attacking momentum, through losses and by the wish to consolidate the ground won At the moment these lines are written official reports declare infantry inactivity about Verdun, although the guns of both contenders maintain a heavy fire

A rather significant condition occurs with the reported reopening of the Belgian Holland frontier, which was closed securely some days before the storm broke around Verdun—at the same time that German troop movements were reported in strength This may mean that the local offensive has ceased for the time being, or the report may be erroneous.

The next move by either Teuton or Entente is very much in the dark Certain activities have become apparent west of the Verdun salient, including the taking by the Germans of a French position in the Champagne, near Rheims, over a front of some 1,400 yards, to a depth of about two thirds of a mile This is scarcely to be taken as the initiation of another general offensive, but merely the seizing of opportunity to better local positions and incidentally keep the French attending strictly to business in sections other than around Verdun.

At the risk of seeming repetition, the existing situation appears to warrant reiteration of the belief expressed in these columns before, that the main object of the German drive at Verdun was primarily for the purpose of strengthening the defensive position in anticipation of activity by the Entente with the coming of propitious weather There was always the dim chance, in addition, that some part of the line might give way before the hammering, a gap be forced and material gains be assured, but any such hope must have been founded upon the chance of tactical or strategic error on the part of the defenders. It is reported that the German forces comprehended reserves held in hand for just such a contingency, which were never sent into battle during the defensive to date

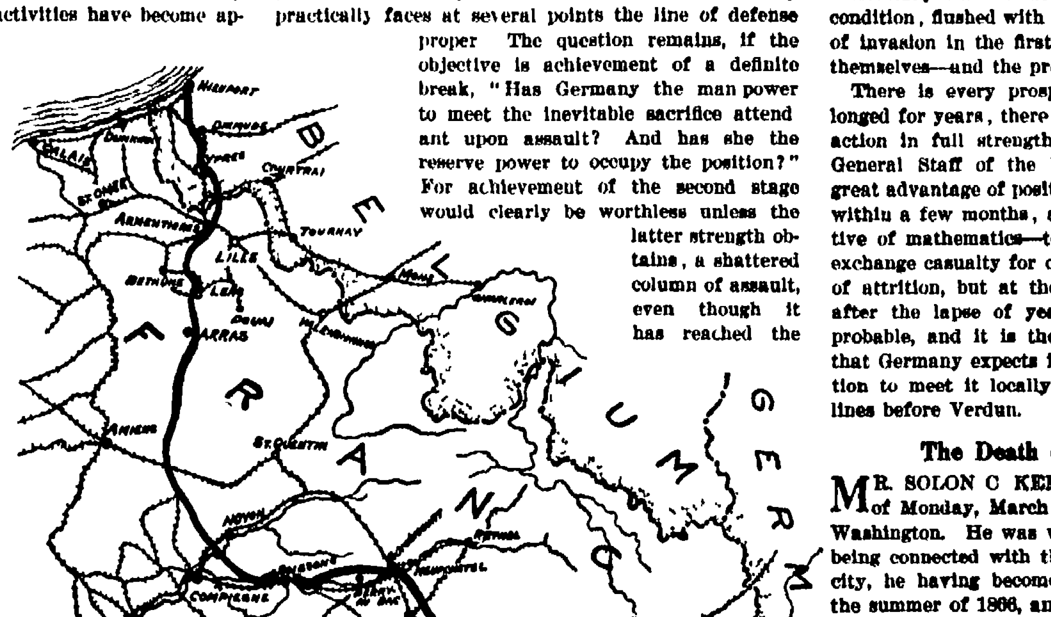
Again, public opinion and the strengthening of morale may have dictated the venture The neutral world has rather consistently expressed the belief that Germany had come to the end of her offensive power, what with losses and the hemming in on all fronts by superior numbers of enemies to the Fatherland which but waited to take advantage of any weakening of the lines before them A general acceptance of such belief might easily militate to sway the decision of officially neutral, potentially inimical states that would mass more force against Teutonia and open new avenues of approach. If the morale objective is a principal one, then the force of arms has been actively supplementing diplomacy, Rumania, of course, is the principal state to be influenced by such display of strength.

No military organization, no directing staff of any belligerent, surpasses those of the Kaiser The waging of war has been reduced to as exact a science as is possibly consistent with the chances of war, the pros and cons of every project have been carefully weighed, possibilities and probabilities have been forecasted and tested, losses to be sustained in the accomplishment of a given objective have been counted with almost mathematical precision and the deductions and results have become axiomatic.

For these reasons, it is the belief of many prominent officers and military analysts that Germany did not expect to break the French line any more than she expected the Entente to break hers in reprisal; the strength of the defensive has been too well demonstrated throughout the war to warrant any such optimistic belief When the phrase "breaking the line" is used, it must be remembered that the main line of defense is not to be found in any of the foremost trenches or positions, the clearing of ground that has been taken up previously as a sort of permanent outpost merely brings the attacking force closer to the real line of defense, the solidly held positions that must be smashed through before a gap is opened to permit the passage forward of troops.

Should an assailant be possessed of sufficient forces to push back this outpost, these advanced trenches, which may scar the earth for several miles, and then still have available enough men to pay the price in blood required for overwhelming frontal assault, and still have, in reserve, an ample force to push through the wreckage and establish itself, then a real break might be made

The situation around Verdun exists to-day at about the completion of the first stage The advance trenches, the permanent outpost, have been cleared along the ground immediately north of Verdun, and Germany practically faces at several points the line of defense proper The question remains, if the objective is achievement of a definite break, "Has Germany the man power to meet the inevitable sacrifice attendant upon assault? And has she the reserve power to occupy the position?" For achievement of the second stage would clearly be worthless unless the latter strength obtains, a shattered column of assault, even though it has reached the works, is useless unless amply supported, otherwise naught but a net loss of men would have accrued from the effort—and some traditions



The battle line on the western front

Germany possesses one tremendous advantage over her adversaries—that of interior lines of operation well latticed by a railway system primarily constructed for just such a condition as now confronts it—warring against multiple power The German staff knows to a T just how long it takes to shift an army corps from west to east, it knows just how long a given force may be depended upon to maintain itself on the defensive Through knowledge of these factors, troops, first line and reserve, may be withdrawn here and there, shifted to other points and used to initiate an offensive blow or stem a tide which threatens.

On the other hand, exterior lines which require that shifts of troops follow the arc convexity instead of cutting across a chord, impose an additional time element upon the force which is compelled to occupy them, if it takes four hours for interior line troops to cross the chord, five hours will be required for a simultaneous shift along the exterior lines to meet it, with a resultant gain of an hour to the interior line. General Nathaniel Forrest of Southern Confederacy fame sized the deduction up crudely but effectively in the words "Git thar fustest with the mostest men."

And this applies in the European war not only on a local front, but throughout the perimeter of the present lines. It is impossible for England or France to reinforce Russia, or vice versa; it is an easy matter for Germany to come to the relief of her Austrian ally—as she has done repeatedly

The present writer has never claimed that Germany and her allies do not possess sufficient force for defense. Belief is entertained that Teutonia has reached and probably passed the zenith of her man-power, but are purposes of general defense there are ample troops available—backed by possession of interior lines. And if the present lines are evacuated, the more the defending line is contracted the fewer men will be required to man it.

Practically every observer anticipates tremendous activities on all fronts with the coming of fitting weather Without doubt, plans are already elaborated for simultaneous attack on all fronts, as the only and only way to offset Germany's ability to shift troops at will The answer to the inquiry as to why France has not launched a counter offensive to relieve the pressure on the Verdun position is probably to be found in the fact that some element of the Entente is not yet ready to actively coöperate in full strength. With one front inactive, Germany would welcome the assumption of the offensive by her enemies on another, strong in the possession of her interior lines It might be that the assailant could be "pulled off his feet" and given a *coup de grace* even at a monumental cost—that might eliminate an enemy

Germany was checked at the Marne by just such a condition, flushed with triumphant success, her columns of invasion in the first weeks of the war overreached themselves—and the present deadlock resulted.

There is every prospect that the war can be prolonged for years, there is the *possibility* that concerted action in full strength, directed by an International General Staff of the Entente, may offset Teutonia's great advantage of position and bring the war to a close within a few months, and there is always the alternative of mathematics—to sit tight, give blow for blow, exchange casualty for casualty and fight strictly a war of attrition, but at the cost of European bankruptcy after the lapse of years. Concerted action is more probable, and it is the personal belief of the writer that Germany expects it and is strengthening her position to meet it locally by the attempt to correct the lines before Verdun.

The Death of Solon C. Kemon

MR. SOLON C KEMON died early in the morning of Monday, March 13th, 1916, at his residence in Washington. He was widely known in Washington as being connected with the office of Munn & Co in that city, he having become connected with that office in the summer of 1866, and had he lived until the coming summer, would have rounded out fifty years of service with the firm For many years he was manager of the Washington office, which brought him in contact with inventors from various parts of the country having business transactions with that office.

During the whole term of nearly half a century with which he was connected with the firm he had become endeared to those having business relations with him, owing to the high integrity of his character and his unswerving loyalty to the firm In spite of physical infirmity and delicate health during the past few years, he rarely absented himself from the office and, in fact, it was with difficulty that he was persuaded to take even an occasional vacation.

The funeral service took place on March 15th, when he was buried in Glenwood Cemetery in Washington.

Brewer's Yeast as a Source of Vitamines

A RECENT report by Mr. Atherton Seidell, of the Hygienic Laboratory, U. S. Public Health Service, describes a successful process of obtaining a cheap and stable vitamine, in concentrated form, for use in treating nutritional deficiency diseases, such as beriberi, pellagra, etc. The preparation is obtained from brewers' yeast, which is pressed, autolyzed by keeping at a temperature of about 100 deg. F. for 48 hours, and filtered through paper, the filtrate then being treated with Lloyd's colloidal hydrous aluminium silicate reagent. Finally a solid residue is obtained by siphoning, desiccation, etc. The preparation has been given to pigeons in doses of 0.05 gram on alternate days, and the pigeons were thus enabled to retain normal health and weight on an exclusive diet of polished rice, which would otherwise produce fatal polyneuritis. Completely paralyzed pigeons have also been promptly cured by this new remedial agent.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

In Behalf of the Centigrade Thermometer

To the Editor of the SCIENTIFIC AMERICAN.

Seeing an article in your February 5th edition entitled "Shall We Abolish the Fahrenheit Thermometer?" and feeling inclined to comment on this subject, I beg to say that in my opinion this is indeed a step in the right direction, and though I disagree with Mr Johnson in that there is no connection between the metric system and the centigrade thermometer, the ease with which calculations may be made on the centigrade basis should make its adoption a desired change

This brings us back to the much discussed subject of changing our entire system from the English to the metric, and while it is generally agreed that the metric has so many advantages over the English as to make its use a great simplification, the transition looms large, and is considered impracticable or even impossible

Therefore, would not such simple steps as the thermometer constitute a movement which would educate us up to the point where we can look upon the revolution with a little less fear

Personally, I may be somewhat prejudiced in favor of the metric system as I am an engineer and have spent a number of years in Mexico, where it is the legal standard, consequently am nearly as familiar with the meter and kilo as with the foot and pound.

C M BARRON

23 South William St., New York city

A Plan for Military Preparedness

To the Editor of the SCIENTIFIC AMERICAN

The great fault to be found with all plans of the administration party is their lack of thorough effectiveness. This remark is not dictated by any political bias, but is used to classify our popular propositions.

We do not wish to identify ourselves with 'German Militarism," either in principle or practice, but a few members of the German General Staff introduced into our councils just now for the sole purpose of indicating the defects of the civilian ideas which dominate our viewpoint would be of great service Suggestions emanating from our trained army and navy circles are of course necessarily thorough and reliable, but knowing the nature and temper of our Congress, these suggestions may be suspected of falling short of the actual convictions of the military authorities from whom they emanate.

Utilizing the viewpoint established by my own thorough military education, followed by service as Commandante in four of the military institutions on the Atlantic seaboard, I beg to submit some of my personal conclusions They may be of value in influencing, at least, the general concensus of opinion.

The term "Large" when applied to a standing army (or navy) is purely relative in character

Two hundred and fifty thousand men for Nicaragua or Cuba would be an enormous standing army, but when the term is applied to a country of vast proportions and 104,000,000 people (the wealthiest aggregate population on earth) it loses its significance "Two hundred and fifty thousand troops" distributed along the four cardinal points of our great republic, utilizing one point as a central location would be proportionately a very small standing army Besides the usual uses of such a standing army, 50 per cent of its officers could be used for detached engineering and educational service in times of peace With large industrial developments impending such an army can be depended upon to control the periodical recrudescence of inevitable industrial anarchy proportioned always to the magnitude and activity of such enterprises, in a country of enormous population and wealth, inexhaustible resources and temperamental energy '

Important as is the rôle of this small army, the part to be played by our navy is incomparably greater. We are immune from invasion by any first-class power and practically released from the necessity of a *continuous line* of fortifications if we possess an effective navy What do we mean by an "effective navy"? Properly understood it is this. Such a navy on the Atlantic station alone, as will equal any other (Great Britain excepted) in armament and *speed*. Superadded to this the fleet should be measurably superior in numbers and speed to allow for accidental circumstances which might lead to defeat of one or more of its units.

Moreover, the Atlantic and Pacific stations should [illegible] a fleet of *equal strength* for two reasons.

First, it is not a remote possibility that some European nation may tempt Japan into an aggressive coalition. [illegible] "internal war", now waged [illegible] the United States gives us an object [illegible] the Panama Canal link [illegible] Atlantic and Pacific naval stations may [illegible]

The logical elimination of Great Britain as a possible adversary should be clear to every un hyphenated, cultured, traveled American.

Note that Great Britain desires nothing that we possess, that in virtue of territorial possessions in North America she is practically a copartner in enforcing the Monroe Doctrine and bound as she is to us by ties of race and blood and the common spirit *of democracy* (in the words of her prime minister), "A war with the United States, is inconceivable"! Especially is this true after we have condoned the murderous methods of one belligerent in this war the grievance of which is far in excess of anything of which Great Britain is capable

THE EDUCATION PROPOSITION

These state school propositions in the interest of preparedness are open to the objection urged against our adhesion to a qualified militia program The National Guard is 'good as far as it goes," of course, unless—as is apt to be the case—it misleads the general public in its ultimate conclusion. To the uninitiated the National Guard uniformed and armed may be a counterfeit of the true effective army We may multiply military schools which will do good to a limited degree, but will be as far from the ideal as the National Guard from our armed regulars The action of the nation in 1862 and subsequent legislation (1890), granting land grants from the public domain upon condition that certain state schools introduce military courses, shows the inevitable result, unless the Government assumes absolute control

Over and above all such substitutes for a West Point training, we need United States schools of military and naval technology constantly operating There should be three tributary to the army and three tributary to the navy, the *normal* number of graduates alone being not less than 1,000 per annum each The modern warfare is rightly described as a ' battle between machines"' The nation possessing the largest number of these with a thorough mastery of mechanical, civil, electrical and military engineering and commercial chemistry (other things being equal), will hold the "winning card" It is well said "Chemistry is King!"

THE COURSE OF STUDY

Under as absolute a direction by the United States Government as West Point itself, although less theoretical and more practical, these institutes should be thrown open to the general public, offering educational possibilities as useful in civil as in military life. A large number of Government scholarships (requiring only *conditional* service subsequently in the regular army) could be annually dispensed A graduate could (except in special contingencies) pass at once into civil life His name, however, would be held and listed as belonging to a special department of the "Army or Navy Reserves" If he should personally prefer a military vocation he should command a commission, if an honor graduate, or a non-commissioned appointment, if a graduate only, on entering the army Condensed into a course of four years (with appropriate post graduate courses for specialism provided) the student should acquire not only knowledge of infantry, cavalry, artillery and naval tactics and aeronautics, but an exhaustive practical technical knowledge of the manufacturing of army munitions and commercial chemistry as well

A practical education of this character is of *great value in civil life* from which these students are not necessarily withdrawn, as is the case with the graduates of West Point. A light "side line" course of hygiene and antiseptic and practical surgery could be carried through three years of the course with a post graduate course for those who desire to qualify as army surgeons.

To the average young man the opportunities presented by national schools of military and naval scientific technology would present an attraction almost irresistible. The large number of scholarships of course would relieve parents of expense Beyond their limit, there could be pay entries of a substantial character, which would inevitably relieve the Government of a considerable percentage of actual costs. In the course of the regular curriculum the vast supplies of munitions necessary to the effective equipment of a large army could be economically accumulated by degrees as an incident of educational cost

These institutions (and all depots, etc., of war supplies) should possess a mid-continental location, preferably points contiguous to the Mississippi Valley Had Germany dominated the military policy of our republic for the last half century, who will contend that she would not have developed the magnificent possibilities of our mid-continental waterway from the Great Lakes to the Gulf The "Gore Navigation Bill" now pending in the United States Senate would long since have been an accomplished fact. Up and down this deepened water course the continental commerce of the nations and our battleships would be passing under their own power The deep water draught of the ocean going vessels could be diminished by detachable caissons.

ITS GREAT VALUE

The educational preparation of a plan as above described would be of immense value to our republic This education is now provided by no existing instrumentality under national control Even West Point does not provide it A man might spend his entire life in the regular departments of the army and navy and possess it only in a very limited degree There will be a large number of young men, moreover who will fail to ' graduate' but who will nevertheless acquire during the period between their enlistment as members of the fourth class and the period in which they drop out, much that will be of value to them in the service of the nation And a thought of supreme importance in the minds of many will be that the *commercial life* of our nation will be *steadily enriched* by a constant inflow of elements, trained and developed in body and brain and technically skilled in useful arts Germany has possessed these elements (in the military sense) in consequence of her burdensome and enormous military system, and scientifically and technically by her numerous schools and universities, utilized liberally by her young men and inspired by the Government *at a nominal cost!* We do not desire to use Germany s methods but we do covet her results, her exhaustive knowledge of scientific warfare, adapted to commercial uses in our peaceful civil life We have the money—we have the brains—let us use them!

(REV) WM M WALTON,

Archdeacon of Arkansas Protestant Episcopal Church.

Concerning Leprosy

To the Editor of the SCIENTIFIC AMERICAN

Thinking that perhaps I can throw a little light on the subject of the controversy between "Uno" and Mr Monroe Woolley concerning the contagiousness of leprosy, I beg to submit the following

About the year 1890 I took a contract to erect some buildings dormitories schoolhouse and residence for the Sisters in charge of the young girl lepers in the leper settlement on Molokai, H I

Among the girls housed in these dormitories, after they were built, were three daughters of a white man named Cross, a carriage builder of Honolulu, and his wife, who was a leper I was well acquainted with Mr Cross

This couple had four daughters after the mother had broken out with the leprosy, the first was taken from the mother at birth and never developed leprosy, though she was 18 years of age at the time mentioned. The other three daughters were nursed by the mother and all developed leprosy Mr Cross, though living in the closest companionship with his leper wife for twenty years, never developed the disease

In the early days of leper segregation in the Hawaiian Islands, the Board of Health permitted non leper relatives of lepers to accompany their sick relatives to the settlement upon the conditions that they were never to return and that they must make their own living I employed a number of them on my work who had been there for many years and who had not contracted the disease. These people were called kokuis.

Dr Strong the resident physician formerly the surgeon of the Spreckles steamship 'Australia," told me that many of these kokuis came to him and begged him to inoculate them with the leprosy in order that they might be qualified to draw rations from the Board of Health

A convicted murderer was sentenced to be hanged and, in order to assist in determining one phase of this question, he was given the option of life imprisonment and inoculation with the virus of leprosy He chose the alternative and was duly inoculated and in five years developed the disease I built a jail for his accommodation in the settlement at Kaulapapa

Father Damien developed leprosy, but I have indubitable evidence that he did not do so by fair means. Father Damien's one burning ambition was to die a martyr to leprosy and become a saint in the calendar of the Roman Church I was in the settlement at the time of his death I was personally well acquainted with him and with his successor, Father Conrady

While I was in the settlement an Englishman, whose name I cannot recall, came there bringing an old-fashioned ten gallon kerosene case full of "gurgon oil," which he claimed would cure leprosy He deposited the case on the porch of my house and I had quite a long conversation with him on the subject. I was satisfied, however, that the regimen he prescribed was so rigorous that no Hawaiian would undertake it if he knew it would cure him

My men and myself were on the job about four months and mingled with the lepers with considerable freedom, though always avoiding personal contact with them, and I do not think there was a moment when any of us thought there was any danger of us contracting the disease

I am taking my data from memory and am not quite certain of them They could be determined by the date of the death of Father Damien, which is, of course, history

Dayton, Ohio. J R. FRASER.

Pancho Villa and a battery of his field artillery

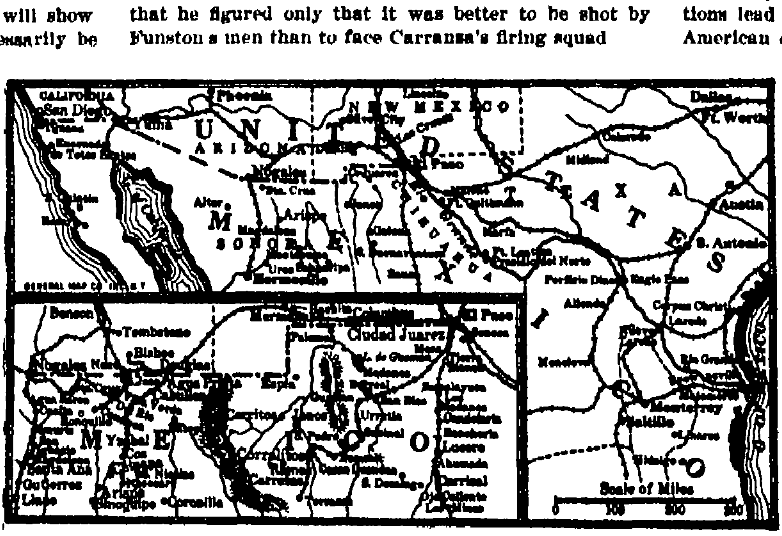
On the Trail of Villa

Our 2,000-Mile Mexican Border and Its Protection

IT is one of the cardinal rules of war, never to do what your enemy wishes you to do In other words, do not let the enemy force you to play his game The present border situation has forced the American Government to violate this rule Just what the result will be, the developments of the next few weeks will show The "waiting" from this time on will necessarily be extremely "watchful"

The ability of Villa must be recognized He is courageous, aggressive and resourceful. His whole career has shown that he is willing to take long chances and to run great risks. After our recognition of Carranza as the head of the de facto government of Mexico, Villa had little left but his life, and that was dependent upon his ability to keep ahead of his pursuers. Having nothing to lose, his only chance to win was to involve the American Government in his trouble and to trust to his luck to get some advantage out of it. Destruction of American property in Mexico, outrages committed against Americans in Mexico, isolated and sporadic raids over the border, brought no action from the American Government. Then came the organized and, in a way, official raid upon Columbus and the attack on American troops at that point. This raid has demanded official recognition and official action on our part. And up to this point, Villa has accomplished his purpose.

We have in the reciprocal arrangement with Carranza, a certain authorization to send our punitive expedition across the border in pursuit of Villa As soon as this is fairly under way, it will be Villa's next move. It is fair to assume that he did not make the Columbus raid for the mere desire of being pursued both by the Carranzistas and by the Americans Nor that he figured only that it was better to be shot by Funston s men than to face Carranza's firing squad



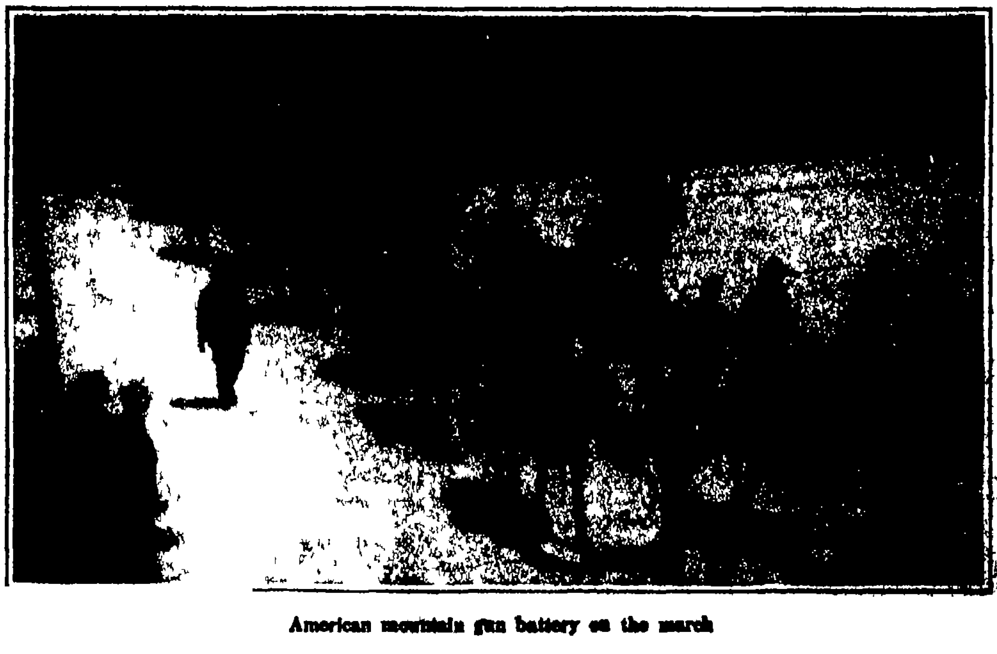
Map of the Mexican border with enlarged insert of the region in which Villa is being hunted

The temper of the Mexican people is well known. Their attitude toward Americans has been unmistakable It is not alone the organized brigands serving as Villa's army, nor the more numerous and better class of Carranzistas, who dislike the Americans, who are suspicious of every move we make, and who are ready for any action against the "gringoes." But the dislike for Americans affects practically all the Mexican people, except those whose business interests and connections lead them to favor the stability and security of American control.

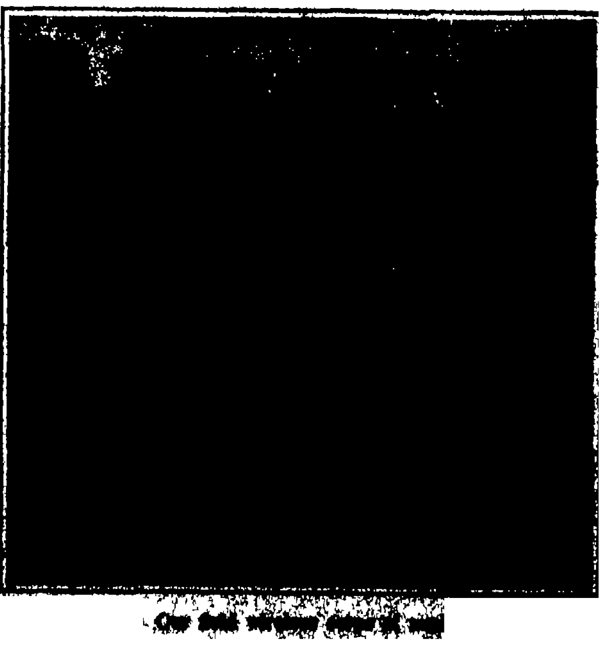
Can Villa arouse the Mexican people to the point of general and united action? Should he do so, he has two grounds of hope. The first is to regain his lost popularity, to become the "liberatador," the idol of the oppressed people, fighting against a foreign invader The other alternative would be to unite with Carranza, and probably Zapata, and restore the status quo of the opposition to Huerta, but this time directed against the Americans.

Villa had and has nothing to lose and everything to gain.

Carranza, on the other hand, has all to lose and nothing to gain by opposing the American policy His desire and interest would be to capture and to punish Villa with his own troops. There are old scores to settle and a dangerous pest to dispose of At the same time, there will be a big credit in his favor on the books of the Washington Administration, if he can do it before we become involved, if we can preserve unbroken our policy of non-intervention and non-interference. Carranza will therefore strain every nerve and use every resource of the de facto government to



American mountain gun battery on the march



Our field [illegible]

gain the prize, Villa's head. Should he fail in this mission, however, and should American troops come into actual contact with Villista forces, should there be an actual engagement between Americans and Mexicans, no matter under what leader Mexicans serve, or for what brand of reform or revolution they may nominally stand, it is questionable whether Carranza can hold the people down.

President Wilson does not want intervention, nor any interference in Mexican affairs. His entire course since his inauguration proves that. The American people do not want intervention. If our people did want it, we should have had it long before this. Least of all do the American troops want it, the officers and men who will have to do the work. It will be a difficult, disagreeable, thankless task. For the forces who do the job there will be no credit or reward except the sense of a hard duty well performed. Carranza does not want it. He can gain nothing by it. But Villa does want every sort of interference and action by our armed forces on Mexican soil. In the sentiment which an American invasion will arouse in the Mexican people lies his only hope.

Therefore, from now on our motto must be "careful watching."

Our army is as well adapted to a chase into mountains and across deserts as any organized military body can be. The criticism directed of late years against our army has been that it has had no training or instruction to fit it to meet a disciplined army of a first class power, that its only experience since the Civil War has been in the Indian fighting in the West and in the irregular warfare of the Philippines. Disregarding the criticism as to the value of our training, we ought now to be well fitted for the task in hand. Our traditions, our experience and much of our training is directly in the line of our present work. There are capable and experienced officers in charge. There are troops enough to meet the present needs. These troops are all seasoned and acclimated by five years' continuous service on the Mexican border. If the future needs are greater, we shall have to follow our traditional American custom and prepare after the occasion has arisen.

After the punitive expedition, the "flying column" of newspaper accounts, has got fairly started, supply columns will have to follow. Troops will have to be left for border patrol and guard duty. How much then will be left of our available mobile army is known to everybody, for all the details of the strength and weakness of our military organization have been matters of public discussion in the past few months, discussions on preparedness. And during these same months we have discussed much and prepared little.

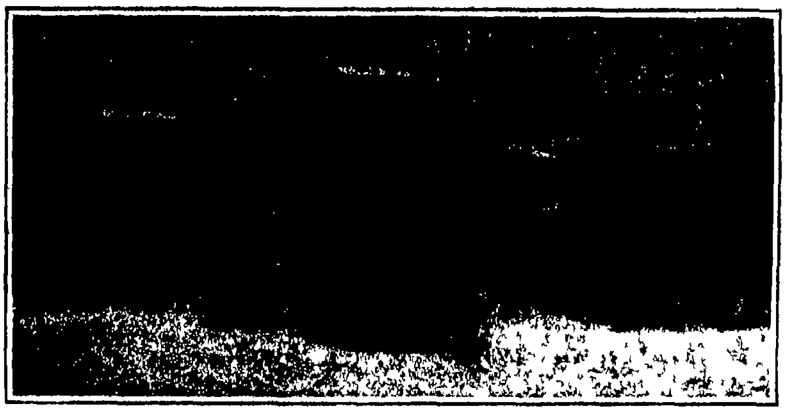
Army authorities have made various estimates of the number of troops which would be required to handle the Mexican problem, based on possible conditions. Nothing has been done to supply the requisite numbers. The protection of the border has been [illegible]

The Benet-Mercier machine gun used by our army

Cartridges are fed in from clips holding thirty rounds. The improper placing of the clip in the slot will cause a jam and failure to function.

New York's Gasoline-Electric Trucks for Garbage-Collection and Snow-Removal Service

DIFFERING from the street cleaning equipment used in any other city in the world, the twelve motor tractor and trailer units now employed in the model street-cleaning district of New York city under the supervision of Commissioner Fetherston are designed to do all the work in that district, including the collection of garbage, ashes and paper refuse in the day, the sweeping and flushing of the streets at night, and the cleaning off of snow in winter. Aside from the multifarious work which they are designed to do and the elimination of all horse-drawn vehicles in the area in which they work, the tractors are featured by the use of gas electric drive and by the fact that they haul huge 20 ton detachable trailers.



Gasoline-electric tractor with a front-end plow in place, ready for snow-removal work

The selection of the gas electric type of drive on the tractors was made for cheapness and operating simplicity. While the electric tractor was highly desirable from the standpoint of ease of operation, the fact that each unit has to work 16 out of the 24 hours every day made its use impossible except by the employment of two sets of batteries because of the mileage limitations imposed upon it by the storage battery equipment. On the other hand, the gasoline tractor with gear transmission, clutch and spark and throttle controls was impracticable because of the great number of stops in collection work averaging from 60 to 100 per hour, and the subsequent slow acceleration between stops, the comparatively large consumption of gasoline during these periods, and the resulting necessity for drivers of a higher class.

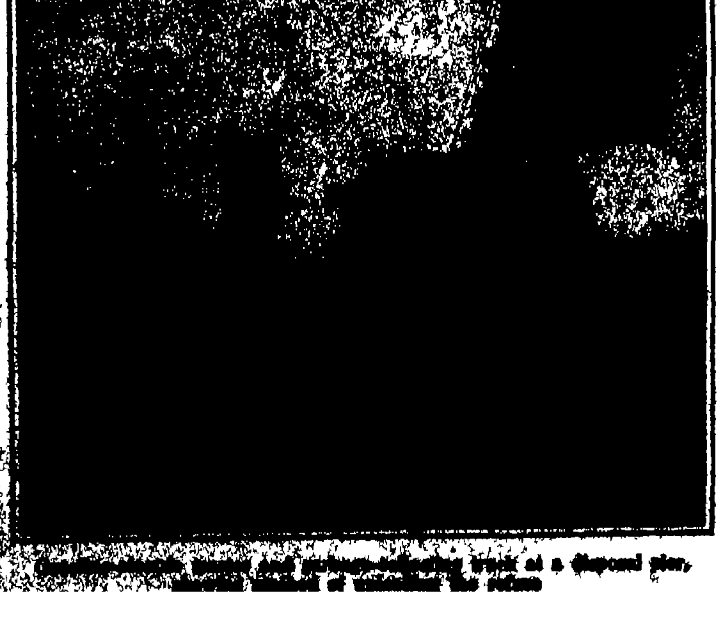
The gas electric type of drive, comprising a gasoline motor directly connected to an electric generator whose output is used in motors driving the rear wheels, combines the desirable qualities of both the purely gasoline and the purely electric tractor. The mileage limitation of the latter is overcome through the generation of the current by means of a gasoline motor instead of being taken from a storage battery. The simplicity of the electric is retained through the elimination of the gearset and the conventional controls of the gasoline tractor, while the comparatively large gasoline consumption of the latter, when the motor is run at normal speed during the many short stops, is eliminated by the use of a special device which automatically cuts the speed of the motor in half when there is no load on the generator.

The governor device consists of a solenoid of the plunger type, which is connected to the throttle lever of the gasoline motor by linkage. It is wired in multiple across the generator terminal through a contactor on the driver's controller shaft, which in turn is so arranged that a slight movement of the controller handle from neutral position in either direction will close the circuit, automatically speeding up the gasoline engine before the driving motors at the rear wheels begin to draw current. Conversely, throwing the controller to neutral automatically reduces the gasoline motor speed to half that when there is a load on the generator.

The solenoid device is locked to be tamper proof. From the moment the gasoline motor is started at the beginning of the day's work, it is kept running without any attention on the part of the driver, its speed being regulated by the solenoid apparatus. All the driver has to do is to steer the vehicle and operate the controller, which gives five speeds forward and two reverse.

Perhaps of equal importance with the design of the tractors is that of the trailers for the collection of garbage, ashes and paper refuse at the same time. The trailers make use of eight double decked steel buckets, as shown in the accompanying illustration depicting the electric crane at the river front

(Concluded on page 336)



[illegible] truck at a disposal pier, [illegible] of unloading the refuse

Removing an upper deck bucket from a garbage-collecting truck

The War Game—II

Service of Security, on the March and at the Halt

By Lieut Guido von Horvath, formerly of the Austro-Hungarian Army

THIS is the second number of a series of map problems which began with the SCIENTIFIC AMERICAN *of March 11th The army organization referred to in the first paper does not conform to American practice Beginning with the present installment, however, the American organization will be strictly adhered to*

The unit of army organization is the division. It is a completely balanced unit having in proper proportions the three fighting branches, infantry, cavalry and field artillery, with the complementary technical, sanitary and supply troops The American division consists of

3 brigades of infantry, of 3 regiments each
1 regiment of cavalry,
1 brigade of field artillery, of 2 regiments, each regiment having 24 guns,
1 battalion of engineers,
1 battalion of signal troops,
Sanitary troops
Supply columns,

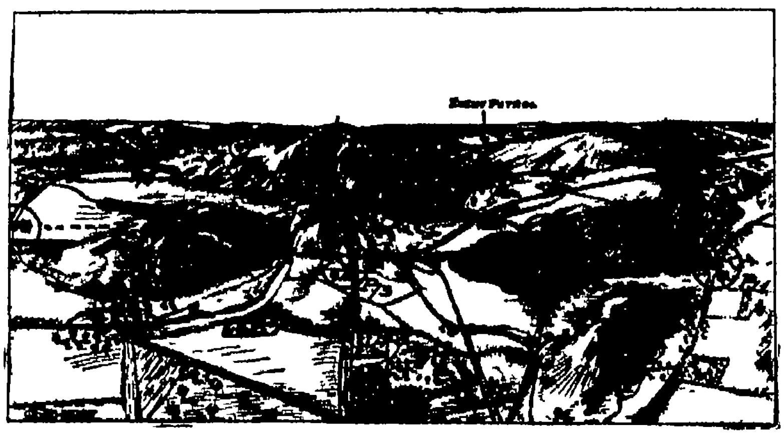
In column, the division occupies about 15 miles of road space With advance guard at normal distances, it is spread out to cover about 21 miles The total strength is about 22,000 men —EDITOR.

THE security of troops when approaching the enemy and when camping or bivouacking in his vicinity demands guarding against surprise This duty is just as important as the leading of these troops to victory Therefore every commander should provide the best protection possible for the troops entrusted to his command

It is evident that the service of reconnaissance which we have explained and worked out in War Game No 1, is closely related to the service of security and that reconnaissance is necessary before the commander can issue the orders to protect his troops while on the march or at a halt

Let us consider the meaning of security in this particular case When we have reached a solution of this problem common sense will suggest a method by which an armed body can protect itself We can find the answer easily if we put to ourselves this question "Against what must troops protect themselves?" The answer will be "Against surprise"

Soldiers are not delicate beings to be sheltered and guarded against attack or battle It is their business to be sent out to attack and defeat the enemy A body of troops cannot do its work if it is in danger of being surprised at any time. If the troops are protected from surprise they can make themselves ready for any action of the enemy Therefore the service of security is so organized that the troops provide for the time in which the main body, the bulk of the fighting force, can make itself ready for a successful encounter



Bird's-eye view of the scene of operations

The service of security divides itself into two phases, providing, first, security on the march and second security in camp or bivouac

The march is protected by security detachments called Advance Guards, Flank Guards and Rear Guards During a forward movement the duties of the Rear Guard are of minor importance, but when a force is obliged to retreat the duty of the Rear Guard is as important as that of the normal Advance Guard in a forward movement

Security when at rest in camp or bivouac, is protected by means of adequate Outpost detachments

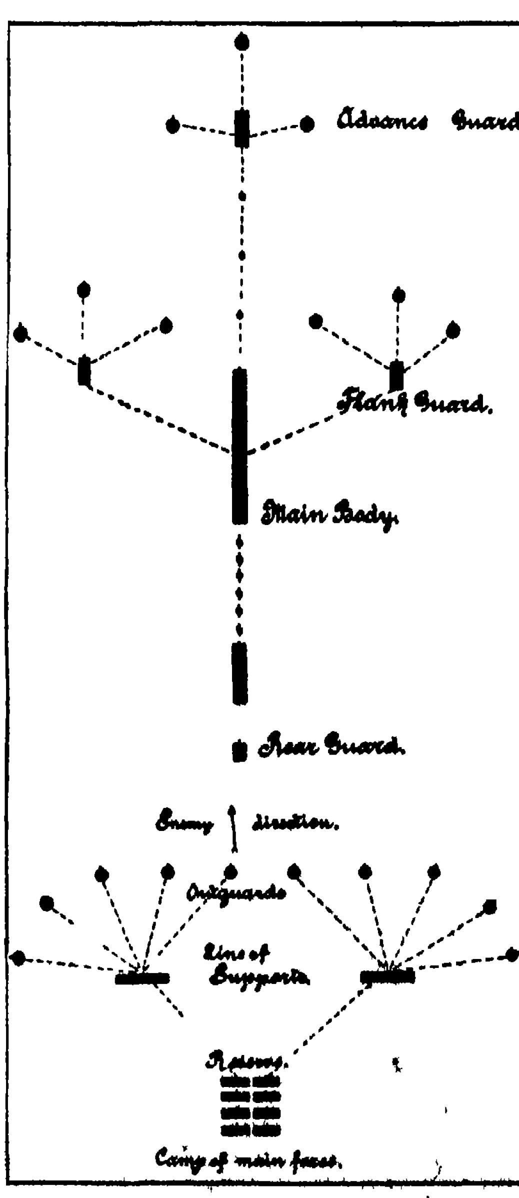
To use a simple example, let us observe the movements of a snail As it moves slowly through the grass it pushes forward its feelers, and it does not move until these feelers give the assurance of safety The feelers of an advancing force are its Advance and Flank Guards. They travel in front of the main body feel out the terrain and search it for the enemy And if this duty is thoroughly done, no surprise can reach the main body

The distance of these security detachments in front of the main body varies according to the terrain and the strength of the main body and the location and strength of the enemy In wooded and difficult terrain the distance will be less than in an open country but it must always be sufficient to allow the main body to get ready and to deploy for action The strength of the Advance and Flank Guards is determined by the same considerations

To give an example We return to our 27th Infantry Regiment, which has just reached Norrisville By this we mean that the main body is in the village Therefore, the Advance and Flank Guards are north of that place The objective for the further march being Pottstown, quite naturally the Advance Guard will be found on the main road leading to that town, while the Flank Guards are on the roads to the right and to the left of the Pottstown road

Here it must be understood that, in addition to the flanking detachments sent out by the Advance Guard, the main body will also when necessary, send out its flank guards To represent graphically the formation of an advancing force, it may be considered as a wedge.

The importance of keeping up communication between all these feelers is just as great here as it is in reconnaissance Indeed it is more important, for greater responsibilities are connected with the movements of larger forces For this purpose men are posted at intervals of 100 or 200 yards between the Advance Guard and the main body, as links to maintain communication. As soon as the Advance Guard halts, the main body will halt, so to say, automatically The halt of the main body of our column at Norrisville again means that the Advance Guard must halt when the connecting links signal forward that the regiment has halted there.



"Security" on the march and in camp

Situation

The detachment, consisting of the 27th Infantry, one battery of field artillery, one platoon of engineers, and the accompanying trains, reached Norrisville at 4:00 P M.

Colonel K commanding the detachment, receives there a wireless message from Captain C, at Pottstown, in which he reports that strong advance forces of the enemy have been observed north of the coal mines.

After a thorough inspection of the terrain, Colonel K decides to halt for the night at Norrisville. Through his adjutant, he sends the following order to Lieutenant-Colonel L K

"The enemy has reached the coal mines north of Nehaminy River in considerable force Our advance cavalry is in Pottstown and its patrols are in close touch with the enemy

"Our detachment will camp in and around Norrisville.

"The Advance Guard will establish outpost on the line Clan Road to Bowers Bridge on the Conestoga Creek, both inclusive In case of attack, this outpost line will be defended

"The battery will take position before sunset, covering the main roads leading toward the enemy

"Outpost will be relieved at 5:00 A.M

"Fires must be covered before dark.

"I shall be at school building opposite church, where all reports are to be sent"

* * * * * *

By wireless, Colonel K sends the following order to Captain C at Pottstown

"Our detachment will camp at Norrisville, with outpost on the line Clan Road to Bowers Bridge

"Move out with your squadron at 3:00 A M. and determine accurately enemy forces north of Nehaminy River Signal results from Lookout Peak as early as possible

"Messages to Norrisville"

Consideration

The reason for Colonel K's decision to make a halt at Norrisville is, quite naturally, due to a long day's march Beside this, the topographical situation is favorable for a strong defensive position, and, on account of its open nature, it gives an assurance against surprise

The outpost service demands from the outpost commander consideration of the following points,

1. The division of the outpost line into sections to be covered by smaller units.

2. The selection of these sections must be determined by the number of approaches toward our position open to the enemy's advance

3. In this case it is a night service, and therefore the location of the outguards must be selected to give the best possible chance to discover every approach. A line of low ground with a sky-line in front which must be crossed by anyone coming from the direction of the enemy has the greatest advantage.

4. It is highly important that the advance elements of the outpost should reach their positions before night sets in.

5. By sending out small patrols from time to time, short distances in the enemy's direction, especially on main roads, the protection can be improved.

6. The communication between the outguards is maintained by small patrols from right to left.

7. The outpost commander, once the line is established, does well to inspect the line, make any desired corrections, and then report to headquarters.

8. Sentries from the outguards, forming the line of observation, challenge all persons approaching their posts, and allow no one to pass, either in or out, unless duly authorized.

9. A sentinel post usually consists of two men posted together, especially at night, for added security

10. The men in the line of outguards should always be ready for immediate action.

11. The reserve usually camps or bivouacs.

A study of the illustration below will give a clearer idea of this service than further description.

The line of outguards is called the Line of Observation, the line of supports is usually the Line of Resistance.

Developments and Questions

The commander of the 3rd Battalion, Major M, having received his instructions from the Adjutant, gives orders for the immediate rest and provisioning of his battalion, then he and his adjutant ride ahead to inspect the topographical situation and to determine the sections for the supports.

1. Where will the Major find the different elements of the Advance Guard? The Flank Guards? With the aid of pins, mark these positions on the topographical map.

2. Find the line Colonel K has selected for the out post line. Try to reason out why this line was selected (Always keep the enemy in mind and that the Colonel wants to protect his command against a surprise by the enemy)

An hour later, after making his inspection, Major M leads his battalion from the village, and while on the march he calls the company commanders together and gives them the following detailed instructions

"Considerable enemy forces have been observed north of the coal mines. Our detachment will camp for the night at Norrisville

"This battalion will constitute Outpost on the line Clan Road to Bowers Bridge. In case of attack this line will be held

"'A' Company will form Support No 1 and will guard the section from Clan Road to the top of Goat Hill 'B' Company will form Support No. 2 from Goat Hill to Bowers Bridge

"Reserve, 'C' and 'D' companies, at Railroad Fork

"Supports will be posted at once to relieve march outpost. Location of supports will be reported as soon as possible.

'Messages to Reserve"

Now, compare the ideal plan of an outpost line with the terrain as pictured in our war map, and make an attempt to mark the points the supports of the out post should occupy Use stick pins

The roads being the most important lines, especially the main roads, naturally they must receive the most careful attention. The supports of the outpost line are therefore placed with this idea in mind

Right now let us get acquainted with the strength of an outguard A platoon is one quarter of a company Each platoon is divided into four squads. The platoon numbers thirty-two men, and the squad eight men. A squad will in most cases answer for an outguard, but important points, like the road leading from Norrisville to Eden, might better be by two squads. A still larger outguard, consisting of a platoon or more, is called a picket.

The distance separating outguards, especially at night, must not be too great. In open country 800 yards will answer In wooded or covered sections, much less. Between these outguards constant patrolling is maintained from one to another.

When the positions of the supports are selected, the commanders of A and B companies will lead their respective companies to these positions: Captain C/1, commanding A company, has decided to occupy the Eden road and to stop at the northern edge of the orchard half a mile north of the road fork. After considering the terrain, he decides to send out six outguards. For this purpose he calls his officers and non-commissioned officers to him when he has reached his position on Eden Road, and gives the following order.

"The enemy has been observed in considerable force 14 miles north of here. Our detachment will camp in Norrisville. Our battalion will constitute outpost on the line Clan Road to Bowers Bridge. This company, as Support No. 1, will guard the section from Clan Road to Goat Hill. To do this I shall send out six outguards

"Sergeant 1, with two squads from 1st platoon, in line with Elm farm, as outguard No. 1.

"Corporal C, with one squad, on hillside near fence, outguard No. 2.

"Corporal C/2, with one squad, 800 yards north of outguard Number 2, on hillside, outguard Number 3.

"Corporal C/3, with one squad, east corner of Berry farm park, outguard No 4.

"Lieutenant L, two squads, main road to Eden, at Berry farm, outguard No. 5.

"Sergeant S/1, one squad, on Goat Hill, outguard No 6.

"Communication to be maintained from right to left Communication on our left flank to be established with outguard of B company, support No. 2, outguards No 1 and No 5 to send out small patrols three miles to the front

"3rd and 4th platoons will remain here as support In case of attack the line will be held

"After establishing positions and communications, I expect reports here."

4 Mark out on the war map the sections of the out guards as established, for A company, support No 1

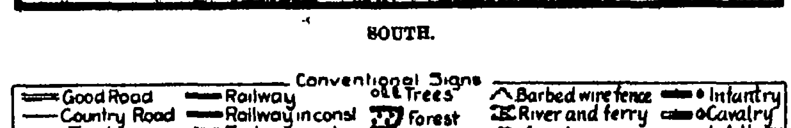
5 Supposing that you are commander of B company, formulate an order to fit the case for this company's duty and mark the result on the map

The Result of the Outpost Service

The night has passed without event. The patrol sent out on Eden Road by Lieutenant L has encountered a small enemy cyclist squad, which was repulsed at the embankment in the road

NORTH.

SOUTH.



Map illustrating the progress of the patrols

At 5·00 A.M Colonel K receives by signal service from Lookout Peak report that an enemy detachment, apparently the flank guard of a large force, is camped at Chester Farm Its strength is three battalions of infantry, half a squadron of cavalry and one battery Their intention seems to be to follow the Nehaminy River Our squadron had an encounter near Green Lake and dispersed one platoon of enemy cavalry and took four prisoners. Our squadron will remain in close touch with the enemy until further orders are received

Answers to Questions in War Game No. 1

1. Lieutenant L reached the railway crossing at 9·00 A.M., and at that time the situation of the other patrols is shown on the map.

2. These men, serving as connecting links between the patrols, have to strive for high points, where they can see and signal to their next neighbor, and so on to their own patrol. This is a very trying duty for both men and mounts, yet it is necessary to carry it out as far as the character of the ground will permit

3 Patrol 1 after entering the Paoly Forest, will be practically out of communication with the others until these woods are passed Patrol 2 by a quick passage of the same forest, can reestablish communication as soon as it reaches the hilltop and with it open country The other patrols have an easy task in this respect

4. Lieutenant L can choose between the ferry closer to his destination and the two bridges and the Island Undoubtedly he will choose the bridges The ferry boat might be on the other shore and more time be lost by taking the shorter road—besides the bridge gives more freedom of action

5 The distance from the bridge to Lookout Peak is about four miles. But this distance must be considered as increased considerably owing to the slow progress which will have to be made in climbing the hill

6 The passage from the double bridge through Pine Forest is dangerously close to the enemy Corporal C has to give up communication with Lieutenant L's patrol In this case the best way would be first of all, to take time to inspect the wooded right shore while two men ride cautiously ahead to the fork above the railroad This once reached, the patrol could follow and, with a quick gallop, the patrol would strive to reach the northern edge of the woods The first action there would be to observe the terrain ahead and then attempt to establish communication with Patrol 3

7 Lieutenant L, once on the hilltop, will, while keeping under cover, utilize the commanding viewpoint in a search of the terrain for signs of the enemy At the lookout tower he will do well to dismount and make another observation

8 On sighting the enemy patrol near Tincum Creek he will remain in observation to ascertain the strength of the enemy Once sure that it is but a patrol, he will try to devise means of passing it unobserved

9 To do this, the curving western slope of the hill, then the trees, finally Hoard's dairy and the forest itself, will serve him excellently

10 Positions are traced on plan

11 The route most promising is pointed out on plan

12 Since he has observed only a single enemy patrol he will not send a message till he has ascertained the strength and character of the enemy to which this patrol belongs

Occurences of Importance

At 6·00 A M the detachment of Colonel K is ready for the march

From Lookout Hill the following report is heliographed to Norrisville

'After an unsuccessful attempt to use ferry at Coal Mines, the enemy has sent out advance guard along the Nehaminy River This has reached Great Pine Tree and is moving southwest along river From a prisoner we have information that the enemy's first aim is Pottstown Several small detachments have reached left shore and entered Paoly Forest."

Almost immediately after receipt of this message an orderly arrives from the Second Division headquarters, to which Colonel K's detachment belongs, with the following order

"Advance to Nehaminy, secure all bridges in and near Pottstown Urgent."

The Third War Game will work out the dispositions of Colonel K

NOTE.—While the map used with this series of war games differs from the maps used by the United States Army, in the method of showing elevations and certain conventional symbols it has been adopted for the sake of clearness to the novice In order to avoid confusion however, the key to the conventional signs will be published under the map in every case After the publication of the preliminary war games, when our readers have become more accustomed to reading maps the terrain will be shown exactly as in the General Staff maps, with elevations represented entirely by contour lines.

Tire Prices

WITH the cost of rubber, cotton and oxide of zinc and even of lamp black steadily increasing it is not surprising that the price of tires is going up How far this will go no one cares to predict, but the tire problem promises to be a serious one for many car owners before many months have passed

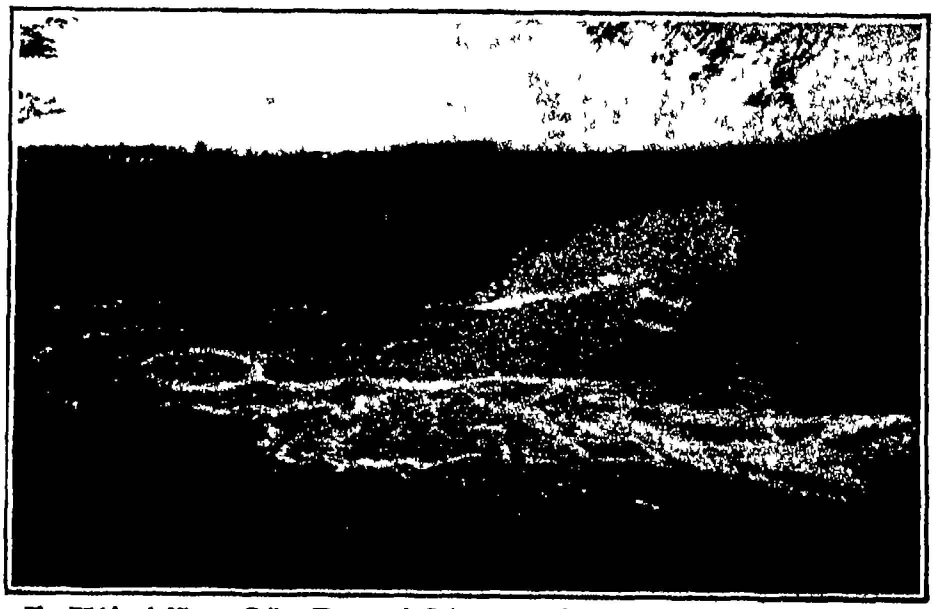
Over the Whirlpool by Aerial Cable

Describing an Aerial Scenic Railway Recently Completed at Niagara Falls

By Chas W. Person

AN aerial scenic tramway 1,800 feet long built exclusively for transporting passengers across the Whirlpool, has been almost completed at Niagara Falls Ontario It is one of the longest, and probably the safest aerial cableway in the world The only other installation of its kind is at San Sebastian Spain, where tourists are transported across a gorge from a trolley terminus to an otherwise inaccessible view place and casino overlooking the Bay of Biscay

The Whirlpool next to the Falls itself is the most popular scenic attraction for tourists According to guide books of Niagara Falls, it is a 'maelstrom a vortex of water, swirling in gradually narrowing circles to a depressed center' Instead, the force of the water pouring into the basin raises it in the middle to a distance of three feet above the outer surface The Whirlpool is the natural result of the mighty body of water rushing into a confined space and seeking an outlet Bodies, driftwood, everything in fact that goes over the Falls must eventually find its way to the Whirlpool, where, after circling for days, perhaps, it is either thrown out upon the bank or carried by the outlet to Lake Ontario.



The Whirlpool, Niagara Falls. Thompson's Point appears directly opposite, and New York State at the right. The dotted line indicates the location of the new cableway

Situated about three miles below the Falls, the Whirlpool is almost entirely within the Province of Ontario The sharp yet thickly wooded cliff that encloses it is a part of the river bank on the Canadian side, so that both ends of the cableway are in Ontario Happily, however, New York State comes in for consideration, for the boundary line between it and Ontario forms an acute angle which is intersected by the cableway about 60 feet within the apex. Because the bed of the river is owned by New York State and the water by the Federal Government—two factors which are small enough in themselves, but which loomed up large in the light of subsequent negotiations—the promoters had to secure permission from Washington and Albany, after they had the sanction of the Province of Ontario and of the Victoria Park Commission of Niagara Falls.

The design of the anchorages was governed largely by the fact that the cableway was not allowed to cross the tracks of the Niagara Belt Line Railway, and by the further restrictions of the park commission that the cliffs on either side must not be altered or defaced, and that no towers or structures of any kind could rise above the level of the tracks of the railway which runs along the cliff

The design of the cableway is based upon Spanish patents, and the enterprise has been financed entirely by capitalists in Spain. The system used is the invention of Torres y Quevedo, an engineer who has gained considerable European fame in aeronautics

The Torres principle is not altogether new to construction engineers in this country It has been applied previously in Canada and the United States to single cables for industrial purposes but not to multiple cables for passenger traffic. It bears the dual distinction of being the only cableway of its kind in the world, and the only one in America

Landing platform and car at Thompson's Point

Coming down to the actual engineering and construction features themselves, the passenger car is suspended from a running gear which travels on six parallel carrying or track, cables each of which is fastened securely at Colt's Point At the other terminus Thompson's Point, each track cable passes over a grooved sheave and is fastened to a counterweight or stretcher These six counterweights are boxes 12 feet high by 6 feet 7 inches wide by 11 feet deep made of riveted steel Each box contains four cast iron pieces of 195 pounds each and 200 pieces of 90 pounds each making a total load of 18,780 pounds, which with the weight of the box itself makes a 10-ton counterweight for each track cable

The boxes are so constructed that they move up and down freely in steel guides. Thus, a sudden load thrown onto the track cables would cause the boxes to rise and the cable span to sag, but the tension in each cable is always 10 tons, regardless of the load on the track cables, that is, regardless of the load on the passenger car itself For the sake of further illustration, if the load on the car is increased, the counterweights rise and the sag in the cables is increased, the cables taking such an angle that the vertical components of the forces acting along them are always equivalent to the weight of the car and its load. Of course, this is disregarding the variations of tension due to the inertia of the stretchers, but they are negligible

The track cables consist of 1-inch crucible steel rope, made up of seven round strands, surrounded by 16 locked coil strands. As these are too stiff to bend over the sheaves at Thompson's Point, each one is fastened, by a standard socket 10 feet in front of the sheave, to a 1¼ inch Monitor plow-steel cable, made up of six strands of 19 wires each, and these latter cables are bent over the sheaves and fastened to the counterweight boxes.

At Colt's Point each track cable is fastened by a standard threaded clevis and socket to a 2 inch rod These six rods are bent around a concrete block weighing 741 tons, which is built into the sheer face of the cliff, and are fastened securely at the bottom of pits which are left open to permit of inspection at any time of the nuts, washers, etc

One of the most novel features of the whole installation is that each track cable is entirely independent of the others This is of the greatest importance. It means that the breaking of any one cable would not be at all serious, as the other cables would support all the weight of the car without any increase in their tension. In the event that one of the cables should break the car would drop several feet suddenly, and, after a few vertical oscillations, would assume a new position of equilibrium Consequently, the breaking of one cable would not endanger the lives of the passengers, and the breaking of two cables at the same time would be nearly as improbable as the simultaneous breaking of two cables belonging to totally separate installations.

The passenger car now in operation at San Sebastian holds only 14 passengers, all standing, whereas the car constructed for Niagara provides seating space for 24 passengers, and standing room in a raised aisle in the center of the car for 21 more besides the conductor When empty the car weighs 5½ tons, when fully loaded, 7 tons. It is 10 feet 10 inches wide, 24 feet long and 23 feet high It was manufactured complete in Spain, and assembled here At the Thompson Point station recently it carried a test load in the form of 223 cast iron weights of 90 pounds each, or three times its maximum passenger load The car is so constructed that should a track cable break at a point just above the car, it would in all probability drop without hitting the passengers, as the carrying wheels extend beyond the basket. Besides, the framework above the basket protects the passengers.

The car is propelled by a ¾-inch 6 by 19 plow-steel traction cable, fastened to one end of the car The cable passes over a sheave on Colt's Point, runs back across the Whirlpool, over a sheave in front of the Thompson's Point station, and to the driving sheave. From here it passes around three sheaves, to one of which is fastened a 16-ton counterweight box, arranged in guides similar to the track cable counterweights, and this creates a tension in the cable

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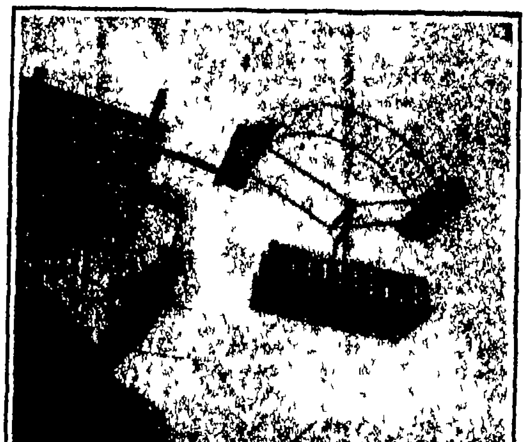


The cable car as seen from below

Cable anchorage at Colt's Point

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Of Interest to Farmers

ROTARY GRAIN CLEANER.—C. QUESNELL, 659 Pettygrove St., Portland, Ore. The invention is particularly embodied in the means for supporting and also shifting or adjusting a series of horizontal rotary rollers, to vary the distance between them, as required for different sizes of grain, also in the means for automatically communicating motion from one roller to another

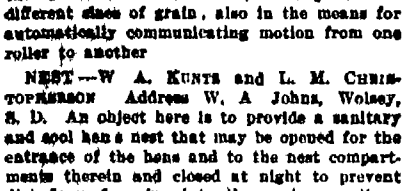
NEST—W A. KUNTS and L. M. CHRISTOPHERSON Address W. A Johns, Wolsey, S. D. An object here is to provide a sanitary and cool hen's nest that may be opened for the entrance of the hens and to the nest compartments therein and closed at night to prevent dirt from dropping into the nest as well as prevent setting hens from occupying the nest.

HOG OILER—R F ARMSTRONG, Address the Atchison Stock Powder Co Atchison, Kan. The roller furnishes a rough surface and the hogs soon discover this, and will rub themselves against it. It rotates as they rub and may also move vertically, and when this occurs the valve will open and a portion of oil or dip will flow down upon the facing of the roller and be transferred to the hog The oil flow is sufficient to keep the facing saturated, and any character of dip may be used instead of oil

Of General Interest

PROTECTING BELT FOR BABIES.—M. R. STERN, 246 E 50th St., New York, N Y This invention provides a simple, convenient, inexpensive, and efficient belt, wherein the child has ample freedom until it tends to slip out of the belt when the belt automatically tightens and grips the child, preventing its slipping out from the belt while unattended in seats on chairs or in carriages

CONCRETE BURIAL VAULT FORM—L. P DUNN, 1527 South 20th St., Terre Haute, Ind The molds in this invention are made of steel plates and are adjusted to make four or more sizes of vaults. The adjustments are effected mainly by the omission of parts thus making it as convenient to make one size of



CONCRETE BURIAL VAULT FORM

vault as easily as another The sides are braced so as to prevent any spring in the molds. The core is provided with clamp clutches, thus making it easy to set up and take down the core without injuring the raw vault. The lid is so made as to prevent seepage due to carelessness in sealing or to broken sealing

MOISTENING DEVICE.—D G BEECHING, 210 E 23rd St., Brooklyn, N Y, N Y The invention provides a device of sanitary nature, the same including a reservoir to hold a body of water and a flexible apron or diaphragm stretched across the top thereof and normally spaced from the water, said apron being depressible so as to touch or pass beneath a portion of the water for the purpose of carrying a film of water upwardly for subsequent use in sealing envelops or analogous purposes

TOOTH BRUSH.—H. REICHS, P O Box 755, New York, N Y This brush is so inexpensive that it may be thrown away after being used a single time A sufficient amount of dentifrice is incorporated in or combined with the brush to provide for a single operation only Thus the construction is far more sanitary and cleanly than the brushes which are now used indefinitely or until worn out.

SYRINGE.—J H PRUITT, Callicoon, N Y The purpose here is to provide a sanitary and scientific device which will glide easily, which will smooth out the mucous membrane and allow any medication to reach the entire surface, thereby soothing and relieving any congestion and which will also carry off anything unhealthy

Of General Interest

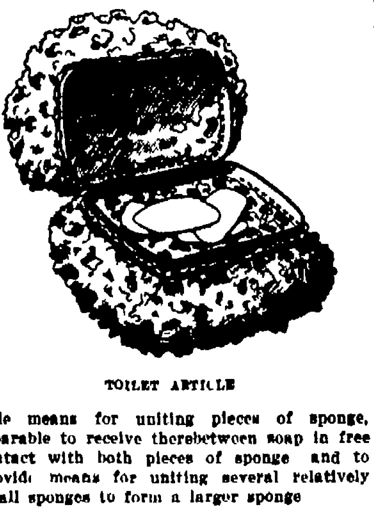
PENHOLDER.—S. GRISWOLD, Camp Point, Ill. The penholder has at its forward end a sheath or case adapted to co-act with the front end of the holder, to hold a pen, the case being removable, and provision within the case and rearward of the pen-holding front end, whereby the pen may be held at the front in proper position for writing, or may be removed and housed within the sheath and held therein when the pen is not in use.

BURGLAR ALARM.—M. BARYIVER, 1235 South California Ave., Chicago, Ill. In the present patent the invention has reference to burglar alarms, and the object thereof is the provision of a simple, inexpensive, and efficient [illegible] which is adapted to fire a cartridge [illegible] person in trying to [illegible] by the said [illegible]

REVETMENT—D. McD. SHEARER, Box 182, Greenville, Miss. This invention relates generally to revetment mats for the protection of subaqueous river banks and shores from current and wave erosion and to promote soil stability, and the object thereof is to provide a practical, economical structure of mat, the units of which are of concrete, whereby it may be placed in strong currents and in great depths of water

REVETMENT MOLD.—D McD SHEARER Box 182 Vicksburg Miss This invention provides a mold particularly for use in connection with the formation of the revetment mat embodied in Mr Shearer's application Serial No 879 644 said mold including novel means for supporting a reinforcing fabric or bonding wires therein about which the several blocks of the mat are cast, said blocks being spaced in order that the mat will be rendered flexible

TOILET ARTICLE—R F HOBBS, care of Hobbs Wall Paper Co, Hoboken N J Among the principal objects which the present invention has in view are to provide a box like member for use as a soap receptacle, to pro-



TOILET ARTICLE

vide means for uniting pieces of sponge, separable to receive therebetween soap in free contact with both pieces of sponge and to provide means for uniting several relatively small sponges to form a larger sponge

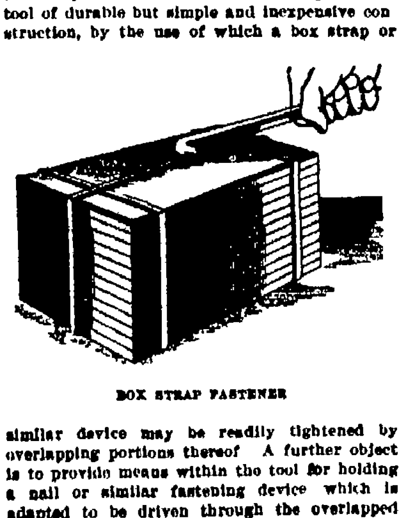
Hardware and Tools

GAGE—E G FOX 651 Fleet St Kenosha, Wis. This inventor provides a device for use in obtaining measures of distances between fixed points, wherein a support is provided having indicators mounted for movement toward and from each other each indicator having means whereby it may be secured rigidly to the support

LOCK—H KORN Aeolian Hall 33 W 42nd St. New York N Y This improvement provides a lock for containers which acts as a plug and which is formed with outwardly extending locking arms or bolts It provides a lock with a pair of locking arms or bolts, one arm or bolt being pivotally mounted on the other, the arrangement of both bolts being such that a single key will cause the simultaneous actuation of both bolts

DEVICE FOR CLAMPING CLOTH.—N H WILLIAMS, 57 St. Charles Ave. Atlanta, Ga The invention relates to a clamp to be used by cloth cutters for clamping the cloth on a cutting table It provides means of simple and strong construction that may be readily adjusted to clamp the cloth and positively hold the same from slipping

BOX STRAP FASTENER.—C H PETERMANN Address H W Robinson, Attorney, 226 229 Hennen Bldg, New Orleans, La The main object of the invention is to provide a tool of durable but simple and inexpensive construction, by the use of which a box strap or



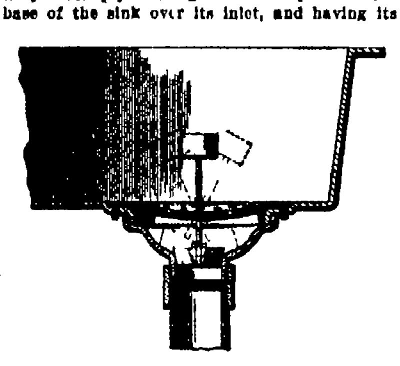
BOX STRAP FASTENER

similar device may be readily tightened by overlapping portions thereof A further object is to provide means within the tool for holding a nail or similar fastening device which is adapted to be driven through the overlapped portions of the strap.

SYSTEM OF HOT WATER DISTRIBUTION—J A WILLIAMS, Aurora, Mo This improvement provides a system of hot water distribution in which the usual hot water tank is employed, whereby hot water may be drawn when desired directly from the heating coil without interfering with the continued circulation of the water through the tank and coils.

LAWN SCARIFIER—W A GORMAN, 1495 Union St., Brooklyn, N. Y, N. Y. In this invention use is made of a handled body and teeth carried by and projecting on opposite faces of the said body, the teeth on one face being longer than on the other face to allow of breaking the ground with the longer teeth and to subsequently reduce the broken ground by the shorter teeth on reversing the implement.

KITCHEN SINK PLUG—E. GROOM, 478 Roselawn Ave, Portland Ore This inventor provides a plug to stop the outlet in a kitchen sink, which may be readily applied to the ordinary drain pipe having a strainer plate in the base of the sink over its inlet, and having its

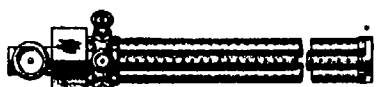


KITCHEN SINK PLUG

end outwardly flared and screwed into the base of the sink. It provides a device which may be securely attached to the strainer plate so as to prevent accidental displacement or loss of the plug

SUGAR BOWL.—C BYERLEY, 102 W 74th St, New York N Y This invention relates to improvements in sugar bowls and the like and has more particular reference to means for discharging a measured quantity of granulated sugar or like material so as to obviate unsanitary conditions due to the use of spoons by various persons for obtaining sugar from a bowl

SPRINKLER—C C COOK 124 E Magnolia St Stockton Cal This invention provides a sprinkler in which a plurality of sprinkling elements are used and independently controlled, said elements being adapted to throw



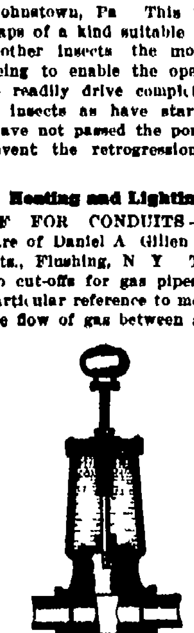
LAWN SPRINKLER

the spray in different directions, thus providing a structure which may be used adjacent a pavement or in narrow spaces without throwing the water beyond the space desired

INSECT TRAP—S KELTONIK 203 Chestnut St Johnstown, Pa This invention relates to traps of a kind suitable for capturing flies and other insects the more particular purpose being to enable the operator, at intervals to readily drive completely into the trap such insects as have started into the trap but have not passed the portions thereof which prevent the retrogression of the insects.

Heating and Lighting

CUT OFF FOR CONDUITS—J GILLEN Address care of Daniel A Gillen Mitchell and N 15th Sts., Flushing, N Y The invention pertains to cut-offs for gas pipes or the like, and has particular reference to means for shutting off the flow of gas between a street main



CUT-OFF FOR CONDUITS

and the interior of a building in an emergency such as of a fire or the like The invention includes a valve casing in which the main pipes are connected on opposite sides and having a valve seat, the valve plug being arranged to drop by gravity so as to obstruct the flow of gas or other fluid through the main

Household Utilities

SPOON—A. E. LYCAN, R R No 1 Box 20 Kooskia Idaho The inventor seeks to provide the spoon or its equivalent with a handle having a special form for preventing the handle from easily slipping upon the edge of a pan or dish, and in doing this for preventing the handle from becoming submerged in the contents of the pan or dish

WASHBOARD—T W CLEMMENTS care of Haysler Mfg Co, Fredonia, Kan. This washboard is so constructed as to permit of any number being packed for shipment whereby the same will occupy a minimum amount of space Another object is to provide a form of shelf for holding a cake of soap thereon and at the same time permitting the complete drainage of water and suds therefrom

CLOSET DOOR FOR STOVES—A OHNEMUS Quincy Ill In this patent the invention has reference to an improvement in oven doors of the type in which various portions are finished in various different ways as for instance some by being enameled and others by being nickel plated and polished etc

HOSE CONNECTION—K O MUEHLBERG 714 S 10th St Manitowoc Wis This invention relates to means for connecting gas water or other hose cocks stoves or other devices and an object is to provide such connections which are positively proof against leakage A further object is to adapt the connection to metallic flexible hose and in such manner as to form a component part thereof although readily removable therefrom

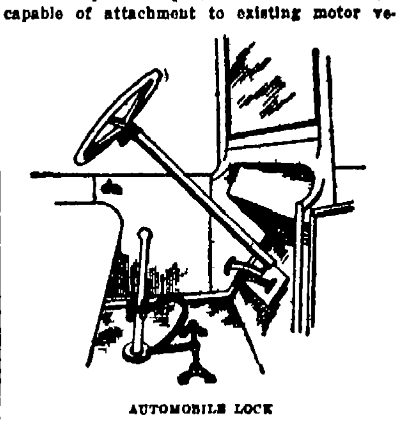
Machines and Mechanical Devices

DEVICE FOR REMOVING STUCK DRILLS—R C CAMERON P O Box 20 Bishop Cal The device has a sleeve with an outer thread with means for securing a drill in the sleeve so that the sleeve may be turned relatively to a second sleeve having an inner thread with which the first thread meshes By this means it is possible to move the first sleeve together with the drill, longitudinally of the second mentioned sleeve thereby withdrawing the drill

METHOD OF WAXING SILK THREAD—C A HAMMOND KNOWLTON 120 E 10th St New York N Y The invention has for an object the provision of the steps or method whereby wax may be forced into the body of the thread It provides a method for not only forcing the wax into the body of silk thread but for removing the excess wax so that the finished product will be a silk thread completely impregnated with wax

PARABOLIC MIRROR GRINDING MACHINE—T A CORRY, care of Ferrocarriles del Sur del Peru Arequipa Peru The invention relates to machines or apparatus for the manufacture and finishing of special forms of reflecting mirrors and has particular reference to machines for concaving and polishing parabolic reflecting mirrors such as are used particularly for reflecting telescopes, head lights etc

AUTOMOBILE LOCK—W J MILES, 1221 Foster Bldg Denver Colo This invention is an improvement in automobile locks, and has for its object the provision of a mechanism capable of attachment to existing motor ve-



AUTOMOBILE LOCK

hicles without change for holding the gear shift lever of the vehicle in neutral position—that is in that position where none of the gears are in mesh during the absence of the owner from the car or whenever else desired

DITCHING MACHINE—C HUNGERFORD, Soldier Kan In this case the invention relates to machines for ditching or grading, and has particular reference to means of this character adapted to be drawn ordinarily by horses or a traction engine and designed for various specific purposes.

ELEVATOR SAFETY DEVICE—P J PROKOP, 536 W 145th St New York N Y The invention relates to elevators used for transporting passengers and freight from floor to floor in buildings particularly that type employing suspension cables for the car and the main object thereof is to provide means for automatically stopping a car in its descent in the event of the breakage of the cables

SAFETY DEVICE FOR ELEVATORS—A J ROSELL 69 Underhill Ave Brooklyn N Y N Y The inventor provides a device for elevators arranged to prevent accidental opening of a shaft door unless the cage has reached and stopped at a landing and to lock the controller in the cage against being actuated while the cage is at a landing unless the door for this landing is first in closed position

PUMP—S A STONE Chillicothe Mo An object in this instance is to actuate the plungers independently and in opposite directions at different times by any suitable means a further object is to telescope the stems for the plungers one within another but in such manner as to be independently operable

BLOW-OFF VALVE—S KAHN, 83 Court St., Newark, N J This invention provides a valve structure of a compound nature embodying

the characteristics of the now well known check valve to retain the air within the tube and having also an auxiliary valve mechanism permitting any excess pressure over the predetermined degree to be discharged while the first mentioned check valve becomes seated, retaining the precise desired amount of pressure within the tube

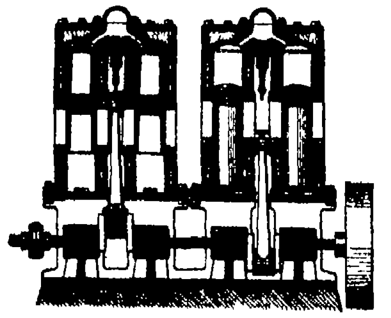
AUTOMATIC SWITCH FOR CONTROLLING THE OPERATION OF PUMPS —K SORGE, 224 E 80th St New York N Y This invention has special reference to an improved pumping apparatus and more particularly to an improved means for automatically controlling the operation of electrically operated pumps such as beer pumps used for storing a tank with air under pressure or otherwise.

Musical Instruments

WHISTLING MUSICAL INSTRUMENT —J J STANTON, 25 Wright Ave Port Richmond S I, N Y This invention has reference to pneumatic musical instruments known as calliopes An object of the invention is the provision of a simple and compact musical instrument in which the strength of the tones may be varied by varying the pressure of the air supplied

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE —S S ERICKSON 644 138th St New York N Y The improvement has for its object the employment of a number of power units such as cylinders and pistons mounted therein said pistons being all operatively connected with a single crank shaft and a single crank thereon by means of one connecting rod and one wrist



INTERNAL COMBUSTION ENGINE

pin One of the features of novelty disclosed is the construction of the frame, whereby the wrist pin may be quickly and easily removed from service position without tearing down, or disassembling the engine.

SPARK PLUG.—H. J BUTLER and L P CASPER, care of the latter 18th and Ormsby Sts., Louisville, Ky This invention provides a plug adapted for use in an explosion engine of any character and wherein mechanism is provided in connection with the plug for preventing the collection of carbon or other deposits between the points of the electrodes clean and bright to insure a fat hot spark

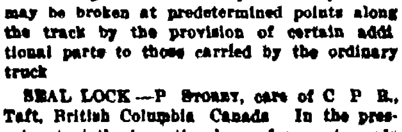
ENGINE VALVE —F F EMORY, 78 Pleasant St. Fitchburg, Mass. This invention relates to steam engine valves and the means for operating the same, and more particularly to that type of engine valves commonly known as puppet valves having double seats. An object is the provision of a valve having suitable guides whereby it is effectively guided to its seat

SPARK PLUG —F MOENCH, Rushville, Ill The present invention has reference to spark plugs, the object being to provide a substantially integral structure which will be strong and durable in use, neat and simple in appearance and, which may be more readily and economically manufactured than the spark plug now in use

Railways and Their Accessories

CIRCUIT BREAKER —F F HUDSON, Dec d Address D M Crawford Builders Exchange, Memphis, Tenn. An object here is to provide a circuit breaker by means of which a circuit on the engine which is kept normally closed may be broken at predetermined points along the track by the provision of certain additional parts to those carried by the ordinary truck

SEAL LOCK —P STOREY, care of C P R., Taft, British Columbia Canada In the present patent the invention has reference to seals for the doors of railway freight cars, and some of the main objects thereof are to provide such

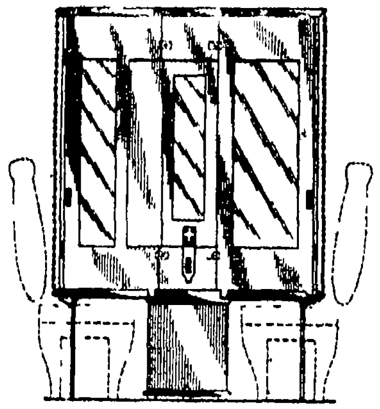


SEAL LOCK

devices which are quickly and easily sealed, wherein there is no possibility of removing the sealing medium without destroying the same, which are highly efficient, and which are comparatively inexpensive

TRAIN STOP SYSTEM —L A GLADDING and J H SULLIVAN Address the former, P O Box 764, New Milford, Conn. This invention relates to a train stop system of that type in which the propelling power is cut off and the brakes set when a train passes a signal set to danger position, when a drawbridge is open, when two trains are within a danger zone of each other and other conditions under which accidents, collisions or the like are likely to occur

PORTABLE STAND —W J CARMINE 515 W Monroe St Jacksonville Fla This invention relates more particularly to stands for railway trains and depots for vending of publications soda water stationery, tobacco etc. In the vending of goods on trains loss by theft and other causes is frequent, owing to the inadequate provision made for the proper storage



PORTABLE STAND

and safe guarding of the supplies furnished to the vender and it is important to provide a portable folding structure that may be temporarily set up in the space between two car seats and afford ample accommodation for the storage and display of goods in large variety and in desirable quantities.

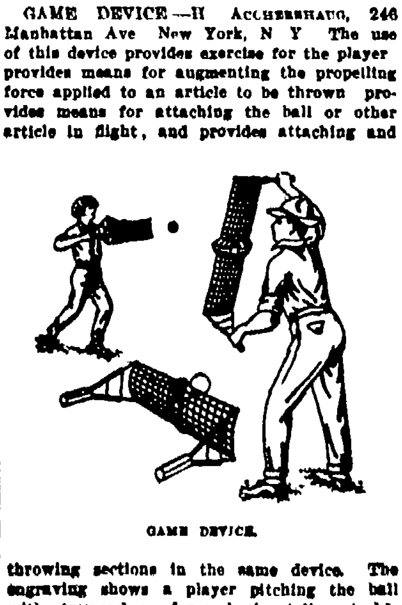
EMERGENCY ENGINE STOP MECHANISM —T W VICKERS R F D No 1 Box 36 El Cajon, Cal This invention relates to apparatus for automatically stopping an engine or train when the traffic conditions are such that a collision or other accident might occur and it relates more particularly to a stop mechanism of that type whereby the propelling power is cut off and the air or other brakes set to stop the locomotive car or train

TICKET HOLDER —A MORTON 77 Broad St, New York N Y The holder is more especially designed for holding a number of tickets such, for instance as are issued for use on street cars elevated roads, subways etc and the ticket holder is arranged to permit the user to conveniently carry it in a vest pocket and to allow the user to rapidly remove the tickets singly whenever it is desired to do so

Pertaining to Recreation

CAROUSEL —W F MANGELS West 8th St Coney Island Brooklyn N Y N Y This carousel is of the portable or knock-down type, and the invention provides a novel form of annular platform for the figures and other passenger carriers the platform being made in sections which detachably interlock with the platform suspension rods, which rods are formed with a special form of hook for engagement with the platform sections

GAME DEVICE —H ACCHERSHAUG, 246 Manhattan Ave New York, N Y The use of this device provides exercise for the player provides means for augmenting the propelling force applied to an article to be thrown provides means for attaching the ball or other article in flight, and provides attaching and

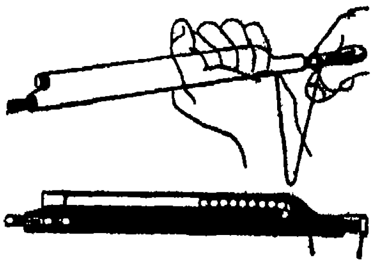


GAME DEVICE

throwing sections in the same device. The engraving shows a player pitching the ball with tremendous force horizontally at his opponent who uses his "net" as a shield and catches at the same time The game may be enjoyed wherever there is a vacant lot and a wall and in reality it is hand-ball on a grand scale

CABINET —W B COOK, Aeolian Hall, 42nd St., New York, N Y This invention relates to cabinets for moving picture projection apparatus, stereopticons and the like, and refers more particularly to a device which consists of a cabinet comprising side and end walls, a reversible and adjustable top adapted to support a projection apparatus or similar instrumentality, and means for holding the top on a plurality of adjusted positions.

TOY GUN.—N B HARMON, JR., Long Beach, Miss. This invention relates to toy guns presenting a repeating toy cannon of simple construction using the pop-gun principle. This



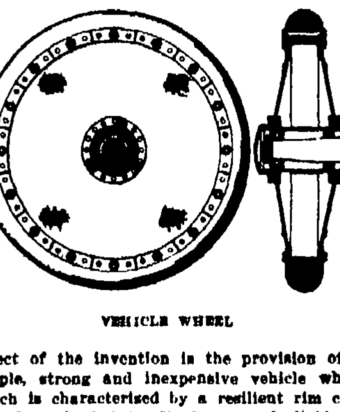
TOY GUN

invention can be made in exact models of European field and siege guns; it makes a very loud report, and it throws its balls to a considerable distance, say over an ordinary house.

Pertaining to Vehicles

AUTOMOBILE SIGNAL.—C P CARPENTER, and J A BOHL, Address the former, 82 Franklyn Ave, North Plainfield, N J This device is especially adapted for use as a rear end signal for automobiles or like vehicles. It is of a practically automatic operation, and indicates to persons in the rear of or following an automobile so equipped that the automobile is about to turn to the right or to the left

VEHICLE WHEEL.—C F ERICKSON, 549 Carlton Ave, Brooklyn, N Y N Y The present invention has reference to vehicle wheels and refers more particularly to the resilient, non pneumatic class of wheels The



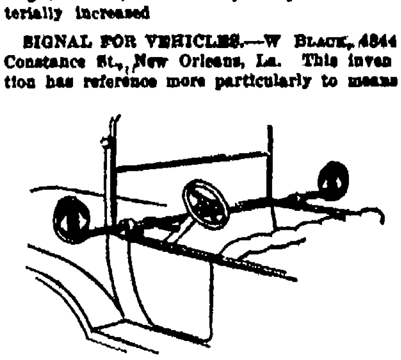
VEHICLE WHEEL

object of the invention is the provision of a simple, strong and inexpensive vehicle wheel which is characterised by a resilient rim connected to the hub by diaphragms of pliable or substantially inelastic material

TRAFFIC SIGNAL FOR VEHICLES.—A D SCHNAARS and C L. JOLY Address the former 81 Sea View Ave Jersey City, N J This invention provides means whereby cautionary and directive signals are automatically disclosed coincident with the operation of a manually-guided and controlled vehicle, provides a device having a containing case for normally concealing the directive members, said case being reduced in its structural dimensions, provides means whereby the stop indication is preceded by a cautionary indication, and provides for duplicating certain of the signals at the front end, as well as at the rear of the vehicle.

LIFTING JACK —G A PIPES, 2115 Miami St Station A, Omaha, Neb. The invention provides a quick acting jack in which the movable part thereof is made in two elements operating simultaneously by a single lever but having a different range of movement, whereby the total lifting action of the jack is materially increased compared with the normal height thereof, and whereby the power is materially increased

SIGNAL FOR VEHICLES.—W BLACK, 4844 Constance St., New Orleans, La. This invention has reference more particularly to means



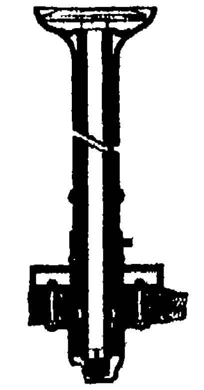
SIGNAL FOR VEHICLES

for indicating to another vehicle in the rear the anticipated movement of the vehicle provided with the signal It provides an efficient signal to promote the safety of vehicle traffic, and provides a signal for vehicles wherein electric energy is utilized for illumination of the sign and wherein there is a closed circuit only when the signal is in operative position.

GEAR CHANGING AND LOCKING DEVICE.—F. F. [illegible], Douglas, [illegible] This invention provides a device more [illegible] designed for use on automobiles and other [illegible] vehicles, and arranged to permit the driver to change the speed gear and to securely lock the same in adjusted position by [illegible] located at the steering post, thus enabling the driver to pay attention to the roadway ahead without distraction when manipulating the changing and locking device.

SEAT SPRING —M G ADAMS, [illegible], Hamlet, N C This invention relates to the suspension of vehicle seats, more especially the rear seats of automobiles, and one of the main objects thereof is to provide means for insuring a practical stability of such seats with respect to the body and running gear of such vehicles, thereby providing a maximum of easy riding quality for passengers, and enhancing the enjoyment of riding.

AXLE HOUSING.—F C. DIRKLA, Burns, Ore This invention provides a housing so arranged that in case of breakage of a spindle.

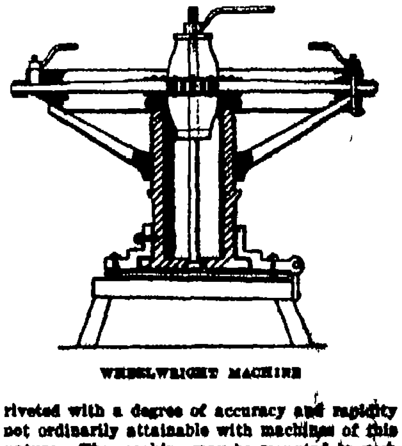


AXLE HOUSING

the broken spindle may be detached and removed and replaced by a new spindle in a minimum of time with the ordinary tools carried by the driver, and without expert attention and without the necessity of providing a new housing for the axle, thus eliminating a large item of expense, a considerable loss of time and delay and loss of use of the vehicle

TRUCK —H. C GUSTAFSON Arlington, Iowa The invention provides a front truck for hand controlled vehicles, wherein the truck is pivotally connected to the body of the vehicle to permit the vehicle to be guided, and wherein brake mechanism is provided capable of being operated from the front end of the truck for applying or releasing the brakes, and wherein a sliding handle frame is provided capable of being expanded or contracted and having latch mechanism for holding the same in adjusted position

WHEELWRIGHT MACHINE.—O B GRAVES, 10th and Maple Sts., Coffeyville, Kan. This invention relates to an improvement in wheelwright machines, and one of the principal objects of the invention is to provide a machine or wheel chuck by means of which a wheel may be respoked, retired, bolted, dished, and



WHEELWRIGHT MACHINE

riveted with a degree of accuracy and rapidity not ordinarily attainable with machines of this nature. The machine may be mounted in such a manner that it may be swung bodily upon a pivot so that the rim of a wheel mounted on the machine, may be rotated within a receptacle filled with water for shrinking the rim onto the felloe of the wheel.

ATTACHING AND CONCEALING MEANS FOR VEHICLE CURTAINS.—F GERNDT, care of Sterling Top and Equipment Co., 518 W. 57th St., New York, N Y The invention comprehends the provision of pockets along the edges of the top adjacent to which the curtains are attached and designed to be folded or otherwise compactly arranged to be retained in the pockets in a relatively concealed position, but in such manner as to be capable of being readily lowered when they are desired to be used.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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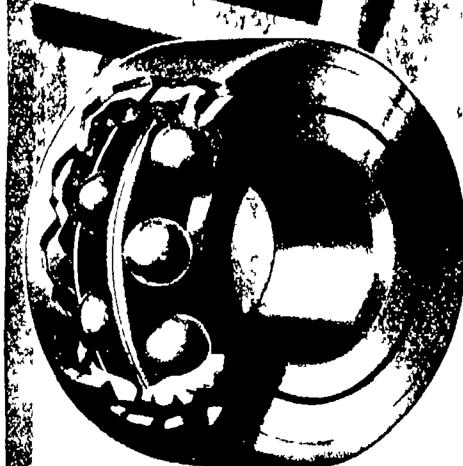

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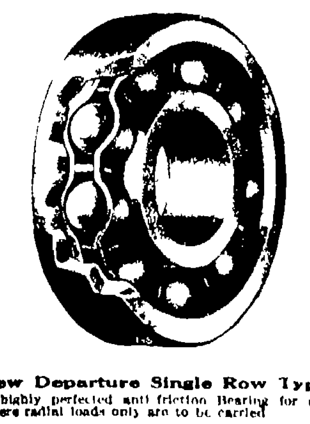

New Departure Single Row Type
A highly perfected anti friction Bearing for use where radial loads only are to be carried

Scientific American War Game

What do you know of the science of war?

Knowledge of military strategy and tactics is obtained by a game of war played with pins and blocks and paper strips upon a contour map The game is as scientific and absorbing as a game of chess We invite our readers to participate in such a game

Owing to the interest this series has aroused we have decided to run the articles weekly instead of every other week as announced last week.

WAR HAS BEGUN!

I.

In the SCIENTIFIC AMERICAN of March 11th we published the first paper of the war game series Enemy patrols had been observed ten miles beyond "Lookout Hill." To gain information about the enemy, four cavalry patrols were sent out from the detachment stationed at "Norrisville"

II.

This week (page 328), the reports of the cavalry patrols are announced, the detachment which has moved forward, encamps for the night and takes measures to protect itself against surprise attacks. What measures should be taken?

III.

April 1st. The detachment now moves forward to a strategic position to engage the enemy in battle What disposition should be made of the artillery, infantry, and cavalry?

IV.

April 8th. In this issue battle is joined, and our readers move over to the side of the enemy to learn of the measures taken by the enemy to defend itself.

In each installment problems are presented for the readers to ponder over Military science is as exact as that of chess These problems have definite answers, and the answers in each case will be found in the following installment

This war game series is being conducted by Lieut Guido von Horvath, formerly of the Austro-Hungarian Army, who is eminently fitted to teach military tactics by reason of his training at the Military Geographical Institute at Vienna.

In strict military parlance the first installment of the series are known as "map problems" A real war game will follow, when two military tacticians will be pitted against each other in military maneuvers. Announcement of this game will be given later

The articles are written so that laymen can understand them

Copies of the enlarged colored map covering the terrain of the war games, which appears on the cover of this number, may be had for 10 cents each.

MUNN & COMPANY, Inc
Woolworth Building - - - New York

Our Vanishing Export Trade in the Products of American Forests

(Concluded from page 319)

lost importance on this side The much considered and anticipated impetus to American shipping may perhaps be an aid to it in any case Such we will hope it may be It is an interesting and an important trade, and we would like to hear again the clatter of American wooden shoes along Dutch streets, and see as formerly the railroad trains of other lands traveling across some rough-hewn ties that came from the forests of North America

An Ingenious Gas Turbine Developed in Germany

(Concluded from page 322)

When a definite quantity of gas had been forced into the explosion chamber the quantity being controlled by the governor according to the load the charge was fired by a number of electric sparks passing between pairs of platinum points arranged in different parts of the explosion chamber The idea was to fire the charge simultaneously at different points, and if possible, to fire the different layers men tioned above. When the charge was fired, the products of combustion were expanded by the heat liberated in the usual way, and when the pressure due to their expansion reached a certain figure, an outlet valve was opened The outlet valve was practically a gate, swinging on hinges that could be opened outwards by the pressure of the hot gases, and that was arranged to be closed mechanically The hot gases passed through the outlet valve and thence through a channel lead ing to a nozzle

The rotor was arranged upon the same lines as the De Laval and Curtis steam turbines It consisted of a disk carrying a number of buckets upon its periphery The hot gases formed in the explosion chamber were expanded down during their passage to the rotor, by the aid of the conical-shaped nozzle, to several pounds below atmospheric pressure The large volume of hot gases thus formed swept through the buckets of the rotor in a similar manner to that in which the large volume of low pressure steam flows through the buckets of the De Laval and Curtis turbines A fan was placed in the exhaust, which enabled the pressure of the gases to be reduced to the low figure mentioned After the hot gases had performed their work in causing the motor to revolve cold air was again forced into the explosion chamber, and through the passages leading to the rotor, but not through the rotor itself The cold air performed the offices of scavenging and of cooling the explosion chamber After the cold air had been flowing through the explosion chamber for a certain time, the outlet valve was closed mechanically and the air then proceeded to fill the explosion chamber, ready for another explosion. The 200 horse power experimental turbine that was made at Hanover had its valves worked mechanically by rods and cams taking their power from the axle of the turbine rotor In the 1,000 horse power turbine, however the valves were worked by oil pressure, a servo motor being employed The arrangement of the servo motor was very ingenious. It was something on the lines of the well known distributor employed on motor cars for directing the ignition to different cylinders The apparatus consisted of two concentric cylinders. The outer cylinder had a number of apertures leading to the valves of the explosion chambers, there were as many apertures as valves to be controlled The inner cylinder was hollow, a pressure of oil being maintained inside it by means of a pump. It had one aperture and was caused to revolve, and as its aperture came opposite the apertures in the outer cylinder, the oil pressure was delivered to the different valves in succession. Thus the pressure was delivered to the air entry valve of an explosion chamber, then it was cut off, and the opposing spiral spring closed the valve, the oil pressure passing on to the gas valve which was opened and closed in its turn, and so on. The explosion

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chambers were arranged to operate one after the other, but not so that those adjacent to each other would fire consecutively. As was to be expected, the 1,000 horse-power turbine was by no means perfect. Troubles arose with the working of the valves, and the writer understands that a firm in a neutral country is improving the turbines.

The turbine was tried with almost every kind of fuel—with gas from a town's gas works, with gas from a producer, with blast furnace gas, with oil of various specific gravities all taken from petroleum, and with coal dust. Coal dust apparently was the only fuel employed that was not satisfactory, and the writer understands that the reason was the same as that which led to the failure of coal dust in the cylinder of an internal combustion engine, viz., the formation of a certain amount of coke. With gaseous and oil fuel, there was no difficulty about obtaining complete combustion. With coal dust there was, and the minute quantity of unconsumed ash or coke led to the valves not working properly. When oil fuel was employed, a spraying apparatus actuated by compressed air was added, very much on the lines of that used with the Diesel engine. The exhaust gases also, which though expanded down below atmospheric pressure, still carried a large quantity of heat were employed to raise steam in a boiler, the steam being used either to drive the gas and air pumps or for the gas producer when gas was taken from a producer for the test.

It is claimed for the gas turbine that it will occupy a much smaller space than a gas engine to furnish the same power, and in view of the fact that electricity is becoming more and more the agent for the delivery of power, rotary motion as against reciprocating motion must be an advantage. The following are some figures that were given out, comparing the relative spaces occupied by, and the weights of, the gas turbine and a reciprocating gas engine, to perform the same amount of work.

The gas engine with blowers and gas boiler, it was claimed, was about a third of the weight of a reciprocating engine to furnish the same power, and it occupied less than a third of the space.

It is claimed also that once the difficulties inseparable from a new form of apparatus are overcome, the gas turbine may be constructed in very much larger units than the reciprocating gas engine. It is claimed that gas engines up to 10,000 horse-power should be possible, while it is remembered that 2,500 horse-power is at the present time practically the limit with reciprocating gas engines.

On the Trail of Villa

(Concluded from page 327)

duties an invading expedition with its necessary supply.

The international boundary line is about 2,000 miles long. El Paso, the base for the scene of the present trouble, is about midway east and west. Columbus and Hachita, the reported starting points of the expeditionary forces, are about 100 miles to the west of El Paso. The physical difficulty of guarding such a line as the boundary can hardly be overestimated. In addition, it must be remembered that an army is not a police force, is not trained for and is not intended to do police duties. An army works en masse. It is organized and trained for the purpose of meeting and defeating the organized military forces of the enemy state. It is not its ordinary function to prevent highway robbery or cattle stealing. It can punish the perpetrators of such crimes, as it now proposes to punish Villa, cost what it may. The protection against violence and crime which an army provides is based upon the fear which it inspires. That fear is caused by the feeling that any overt act will be followed by a swift, sure and terrible punishment. Our border army has inspired no such fear. It has been tied down by a policy of very unwilling inactivity and non-interference. [illegible]

have taken these liberties until now they have gone too far

We have kept our army on the border for five years For all that time the hands of the army have been tied Now we must be willing to pay the price which our past policy demands

New York's Gasoline-Electric Trucks for Garbage-Collection and Snow-Removal Service

(Concluded from page 327)

dump lifting off the upper deck The lower buckets are arranged in two longitudinal rows of four each set into the trailer frame On top of these are two other buckets with V shaped bottoms and side doors The latter are opened to permit the men to dump the cans of garbage or ashes into the eight buckets on the lower deck, the paper and other refuse collected being thrown directly into the two upper buckets from the sidewalk

In unloading at the disposal pier, the upper buckets are lifted off first dumped into scows and then set down on the pier floor Then each of the lower buckets is hoisted out and dumped in a similar manner They are then loaded back on to the trailer in the reverse manner, when the unit is ready to return to its next point of collection

The sweeping and flushing of the streets and the plowing of snow in the winter is to be done by special trailers but the city authorities have not yet appropriated the money for the purchase of these The tractors were used to plow snow during the recent storms, however by uncoupling the trailers and applying the conventional front-end plows as shown in one of the accompanying views.

Unit Design in Marine Wireless Telegraphy

(Concluded from page 328)

panel sets are of the noiseless quenched gap type and the occupants of suites de luxe on ocean liners need no longer fear a series of sleepless nights brought on by the nearby crash of the wireless key Nor will the relaying of messages figure so prominently in the daily routine, the high pitched musical note which replaces the former rasping crackle can be read by the receiving operator through static which would make unreadable a note of lower frequency Obviously, this penetrating note is also of great advantage in handling message traffic in congested waters and will make for more efficient communication in difficult harbors such as that of New York

The 2 kw 500 cycle transmitter, as clearly shown in the illustrations, has all the regulating and manipulating appliances readily accessible, with the turn of a single handle to the desired position a change of wave length from 300 to 450 or 600 meters can instantly be effected This switch adjusts all circuits and enables the operator to secure flexibility of control in eliminating interference A wattmeter which indicates the amount of energy consumed at the terminals of the transformer is also mounted on the upper section of the panel By its side is a radiation meter which indicates the current flow in the aerial circuit and below a motor field rheostat for variation of the speed of the motor generator, and a generator field rheostat to vary the generator voltage Between these rheostats is an indicator handle which effects the variation of inductance in the aerial circuit and indicates the amount in turns At the lower end of the section a handle is provided for the variation of coupling between the closed and aerial circuits. A switch which permits transmission on extremely lowe power completes the upper section equipment.

A second or center section of the panel is mounted on hinges and carries the quenched spark gap, this section can easily be swung open from either side whenever it is necessary to remove or replace the condenser jars

The starting appliances, control switches and protective devices are all mounted on the lower section.

Both quenched and rotary spark gaps are used, the latter being mounted on an extension of the armature shaft at the

generator end. The rotary is of the synchronous type with the same number of spark terminals as the generator has poles. Both quenched gap and rotary are served by a pressure blower mounted on the rotor, furnishing air to the quenched gap and ventilating the rotary gap itself The closed core type of transformer is provided with a protective spark gap at the terminals of the secondary, which permits a discharge to the grounded case of the transformer when the potentials be come excessive.

The various elements for the reception of signals are contained in the receiving tuner illustrated. A crystal detector is used When the receiving circuits are thrown into operative position by the antenna switch the primary circuit of the transformer and the generator field opens and the motor stops. When the switch is thrown to transmitting position the receiving circuits are automatically short circuited and thus protected from the transmitter The motor generator may be kept running continuously by closing a single pole switch

By the addition of storage batteries the set can be operated independent of the ship's power when this fails, as is often the case in shipwreck.

Over the Whirlpool by Aerial Cable

(Concluded from page 330)

which adjusts any slack caused by the rising and falling of the car After passing around another groove in the driving sheave, the traction cable passes out to the other end of the car

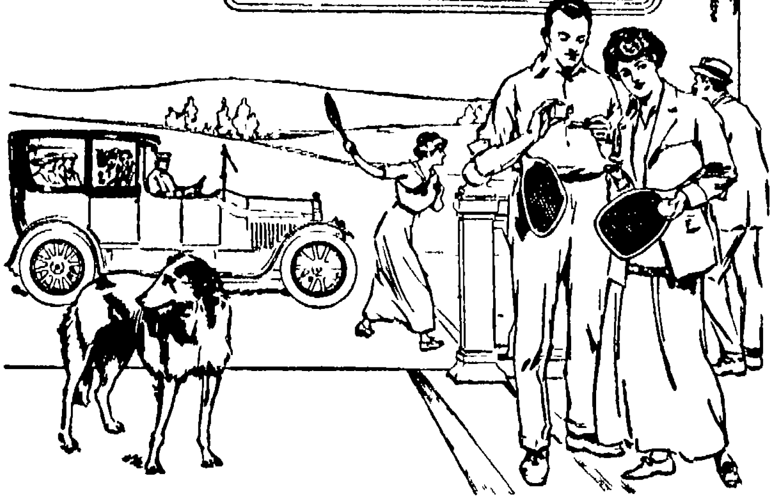
The 8-foot driving sheave is turned by a 75-h p. electric motor, through a 30 to 1 worm gear, giving a speed to the car of about 400 feet per minute when the controller is at full speed Although the trip can be made in about 4½ minutes, it is planned to permit it to occupy 6 minutes by running at half speed part of the time

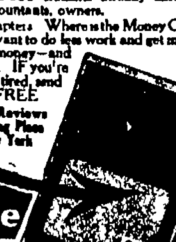
For provision against a possible break down of the motor or interruption in the power supply, there is a clutch in the driving shaft by means of which the motor can be disengaged, and a 5-h p gasoline engine engaged both through a worm gear and through sprocket wheels The speed at which the gasoline engine would haul the car would be very slow but it would be ample to meet the emergency

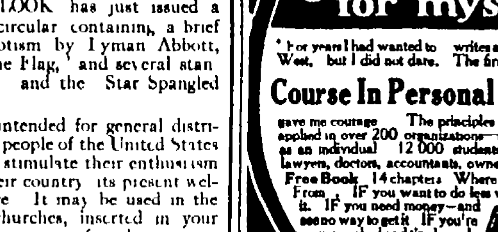
Another safety device which is unique concerns the automatic control stop at each terminus, which stops the car without jar within 8 feet 4 inches The traction cable runs longitudinally through the 5-inch pneumatic cylinder and through the center of the piston. Just ahead of the car on the traction cable is a clamp which strikes the face of the piston, and engages with it in such a manner that the car cannot slip back from the landing platform In fact, the car may be said to be locked the moment it comes in contact with the automatic control stop.

The gates at both ends of the car, which are operated by the conductor by means of a crank, cannot open until the clamp has engaged with the stop piston, releasing a ratchet under the car Even then only the right gates can be opened, that is, the gates at the end of the car where the clamp has engaged When the car starts the clamp is disengaged by another crank, but this cannot be done until the gates are shut This is contrived by interlocking discs enclosed in a locked box on the car The pneumatic cylinder is supported by a counterweight, so that its weight does not rest on the traction cable

A further illustration of this safety device is afforded by the two limit switches at each terminus. The first is always struck by the floor of the car, and affects the controller so that the power is turned off and cannot be turned on again in the same direction, and so jam the car against the station. The second limit switch is hit only when the first fails to operate, and when the motorman fails to turn off the controller, and when the pneumatic cylinder does not bring the car to a stop This second limit switch acts directly upon the circuit-breaker, bringing the car to rest within 3 feet, and without letting it come within dangerous distance of the station.







NEW BOOKS, ETC.

Egypt of the Egyptians By W. Lawrence Balls. New York Charles Scribner's Sons, 1915 16mo, 266 pp.; illustrated. Price, $1.50 net.

Despite the author's deprecatory admission that nine years' residence does not necessarily qualify him to write of Egypt and the many contradictory features it presents, the volume he gives us is a remarkably well written and intense study—not of the Egypt of the tourist but particularly of those four things which according to a recent statement of His Highness Sultan Hussein Kamil, make Egypt the country most blessed of God in all the world—the generous Nile, the unfailing sun, the miraculous yielding land and the industrious fellaheen" The volume summarizes the country's history, sketches its scenery and antiquities, discusses its products and its possibilities, and gives some idea of the problems confronting the British Protectorate The system of irrigation is the subject of careful explanation and constitutes perhaps the most interesting section of the book

English Railways Their Development and Their Relation to the State By Edward Cleveland Stevens M A New York E P Dutton and Co 1915 8vo, 332 pp, 2 maps. Price, $2.25 net.

This study was undertaken with the conviction that a detailed historical account of the consolidation of English railways would possess a distinct practical value No attempt is made to deal with problems of the present instead a groundwork of impartial information is offered, upon which the student may erect his own superstructure and arrive at his own conclusions. In compiling this history many sources have been drawn upon and a list of the more important of these sources prefaces the account Railway amalgamation is dealt with in all its phases and the legal aspects of the situations are made clear by quotation from and reference to, unimpeachable authorities In conclusion the author tabulates the geographical and single track mileage and the paid up capital of eleven leading companies emphasizes the negative quality of past legislation and shows the heavy burden which inflated land values and public opinion have imposed upon the English roads, with their obvious relationship to transport costs.

Practical Perspective. By Frank Richards Associate Editor American Machinist and Fred H Colvin New York The Norman W Henley Publishing Co 1916 58 pp, illustrated Price 50 cents

These brief papers lay down rules for the use of isometric perspective in shop drawings The method is not of course put forward as a substitute for the mechanical or working drawing but it offers advantages in certain cases and enables a workman quickly to grasp the actual shapes and relationships of various parts

Anthracite An Instance of Natural Resource Monopoly By Scott Nearing Ph D, University of Toledo Philadelphia The John C Winston Company 1915 12mo 251 pp

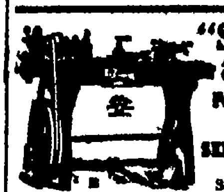
Dr Nearing gives us a very explicit statement of the anthracite situation he discusses costs in definite figures condemns monopoly in natural resources and treats the subject from both the worker's and the consumer's points of view It is a well written and studious treatise worthy of the attention of the 10 000 000 families who largely constitute the consumers of the output

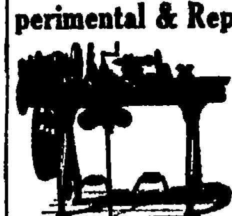
Theaters and Motion Picture Houses By Arthur S Meloy, Architect New York Architects Supply & Publishing Company 1916 8vo, 121 pp, illustrated Price, $3

The large increase in the number of buildings devoted to public amusement, and particularly in picture houses makes this monograph on theatre construction and equipment timely and valuable The work takes up fire proofing features, sight lines, or the radius of vision the pitch of floors, the planning and location of stairways exits, and fire escapes, and methods of seating the proscenium arch and curtains and the stage receive their due share of consideration Tables give the seating capacity and stage dimensions of numerous theatres, and the comparative laws of various cities. There are many good plates of exteriors, and the author's line drawings serve to make his comments immediately understandable to the reader

Plane and Solid Geometry By Webster Wells, S B, and Walter W Hart A.B New York D C Heath & Company, 1916. 8vo, 467 pp, illustrated.

Wells's 'Essentials of Geometry" is the basis of this text in which great care has been taken to align the methods of the older work with modern scientific and pedagogical modes of thought Each section first presents the fundamentally important theorems which naturally constitute a minimum course these are followed by supplementary applications, from which a selection may readily be made Most of the propositions are succeeded by well-chosen exercises, quite sufficient for a shorter course In the chapters devoted to solid geometry the mensuration theorems for the common solids are given first place This emphasis, and the inclusion of certain natural applications of solid geometry in the exercises, give the work a practical trend.





New Lubricant Prevents Rapid Formation of Black Solid Matter in Your Engine

The heat in your automobile engine turns part of ordinary oil into black solid matter—the greatest enemy of lubrication, a cause of rapid wear.

Ordinary oil breaks down after a few hours use, forms black sediment and loses in lubricating value Ordinary oil cannot stand up under the terrific heat of an automobile engine The sediment is destroyed oil all lubricating value in it has been killed by heat

Solid matter means friction The sediment has an inactive or negative effect It partially crowds out the remaining liquid oil This under supply of oil to the metal surfaces causes friction -heat -wear--loss of power and expensive repairs

When tests are run with the same motor under precisely the same operating conditions using different lubricants, a remarkable variation will be found in the amount of oil destroyed by heat This is shown by the amount of black sediment which settles out of each after standing

The oil floating above the sediment is red in color by transmitted light and may be assumed to be as serviceable as when fresh

The volume of sediment formed, and the rapidity with which the oil is destroyed depend upon its chemical structure Oils which have a non heat resisting chemical structure are unfit for use in any type of automobile or other internal combustion motor

Such oils make trouble and increase maintenance cost in direct proportion to their rate of destruction when exposed to heat Consequently the amount of oil used and the cost of lubrication per mile depend not on the price per gallon but on ability to resist heat

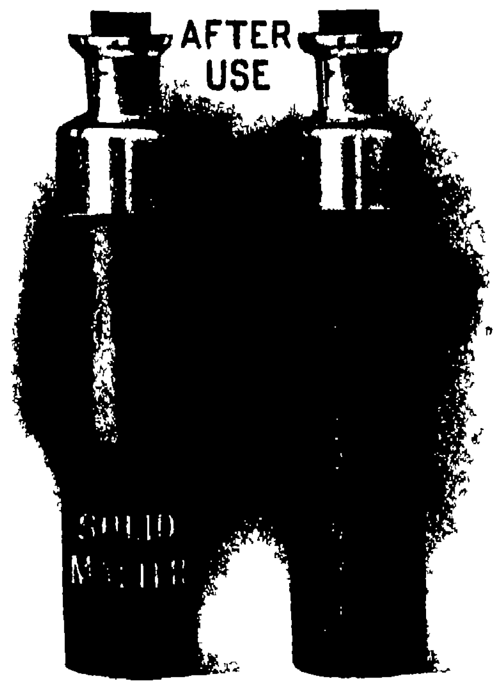
Relative Oil Destruction

The contents of the two bottles shown illustrate clearly the relative durability of ordinary oil and of Veedol the new lubricant that resists heat Veedol deposits only a small fraction as much sediment as ordinary oil The operating temperatures shown on the sectional drawing of the motor bring out forcibly the intense heat to which motor lubricants are subjected

There is a fundamental difference between ordinary oils and Veedol

Ordinary oils are unstable and therefore unserviceable because of non heat resisting chemical structure

Special processes of manufacture developed by this company and the use of Pennsylvania paraffine base crude oil give Veedol, the new lubricant its unusual chemical structure, and its remarkable heat resisting ability



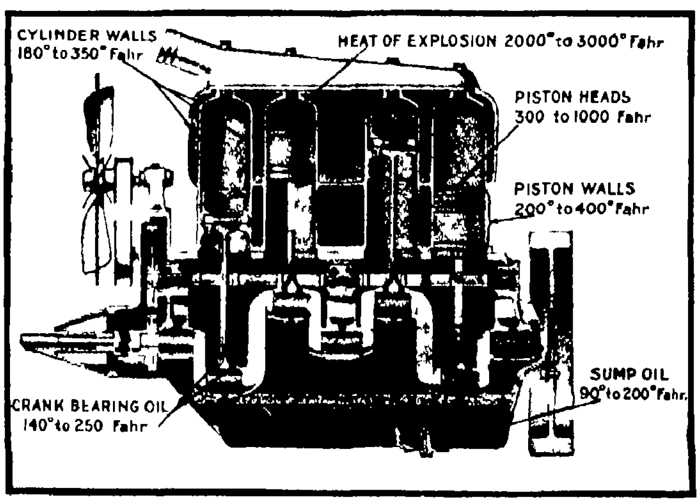
ORDINARY OIL AFTER USE — VEEDOL AFTER USE

Showing Finely Divided Solid Matter in Suspension

Make This Road Test

Remove the drain plug from the lowest part of your motor crank case and allow all old oil to run out Replace the plug, fill the sump up to correct oil level with kerosene and run the motor slowly under its own power for about thirty seconds, to cleanse the interior Then draw out all kerosene, replace the drain plug and refill with Veedol

The exact amount of fuel and oil in the car should be recorded and a reading of the speedometer taken before starting Then let a test, be run over a familiar road including steep hills and straight level stretches, for any distance up to five hundred miles or more



These High Operating Temperatures Cause Rapid Destruction of Ordinary Oils

You will find that your motor has acquired new pickup and hill climbing ability, due to the maximum mechanical efficiency made possible through Veedol

You will find your mileage on both gasoline and oil increases You will reduce your carbon trouble Your motor will have more power

What It Means In Actual Saving

The average mileage of all automobiles is conceded to be approximately 6000 miles per year, and the annual expense of operating the typical or average car ($850 car), as figured by an expert statistician, is approximately $416 per year

Depreciation repairs and gasoline come to about $268

This new lubricant resists heat and prevents rapid sedimentation. This means less wear, less expense, more power.

Solid matter in your oil means friction and wear Friction and wear mean expense Thus expense varies in direct proportion to the amount of black solid matter formed by the oil For this reason, ordinary oil runs up your repair bills, lessens your gasoline mileage and by shortening the life of your car, materially increases your depreciation costs Engineers state that fully 50% to 75% of repairs and 50% of depreciation are due to improper lubrication

Veedol prevents rapid sedimentation and saves you money on three of the greatest items of expense

The cost of accounting records of taxi-cab companies, bus lines and large corporations shows that Veedol should save you from $50 to $115 per year on gasoline, repairs and depreciation

Since Veedol wears several times longer than ordinary oil, your lubrication bill itself will actually be smaller when you use Veedol

If you are interested in saving money you will be interested in making your own tests of this remarkable new lubricant

Get a five-gallon can of Veedol and make the road test described

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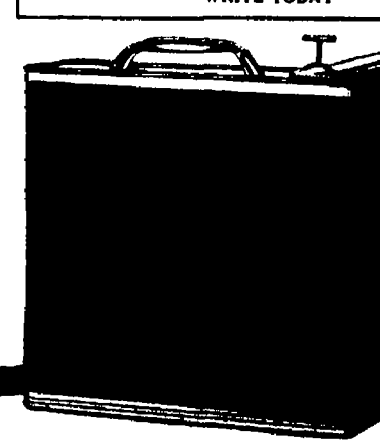

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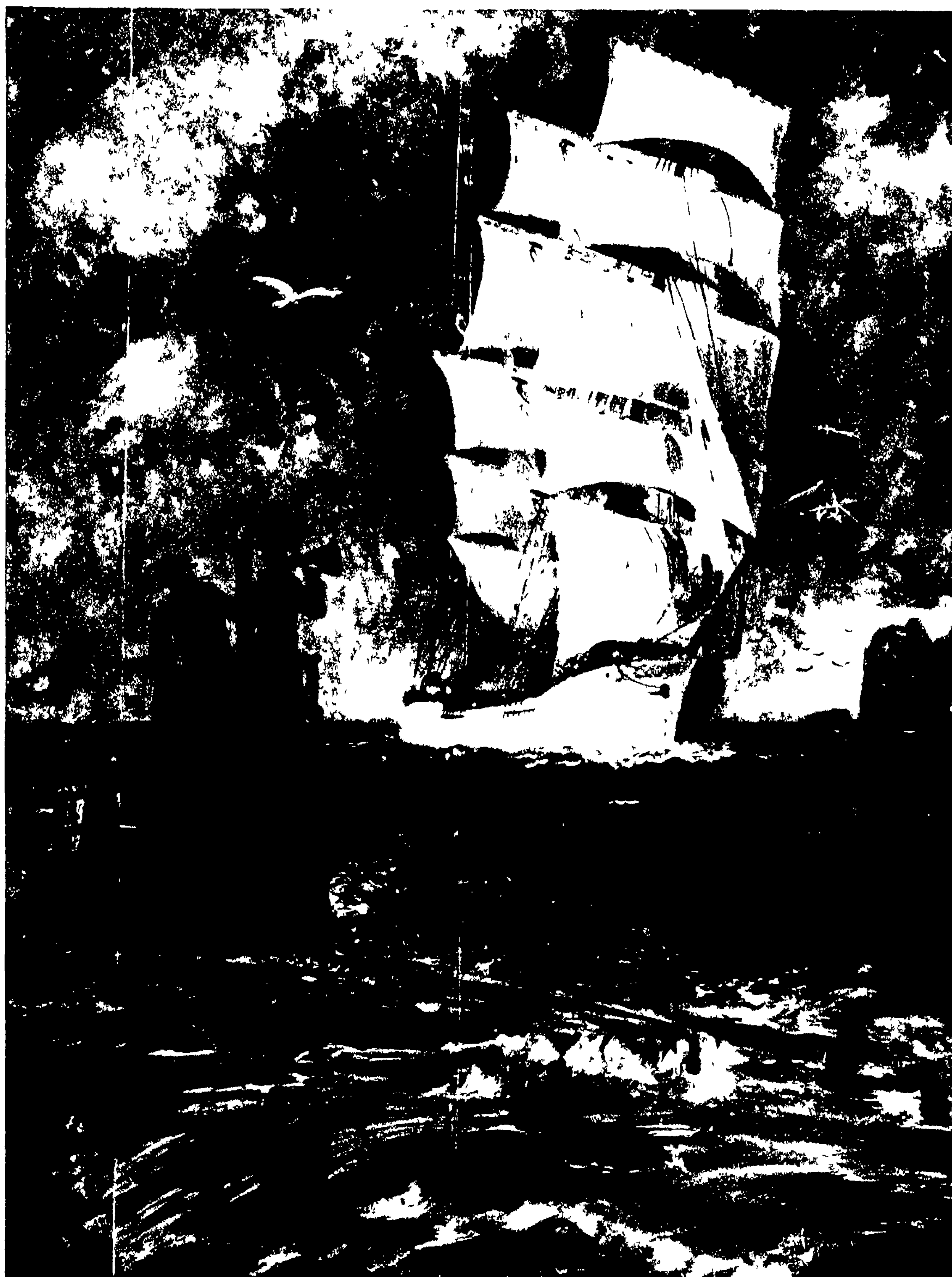

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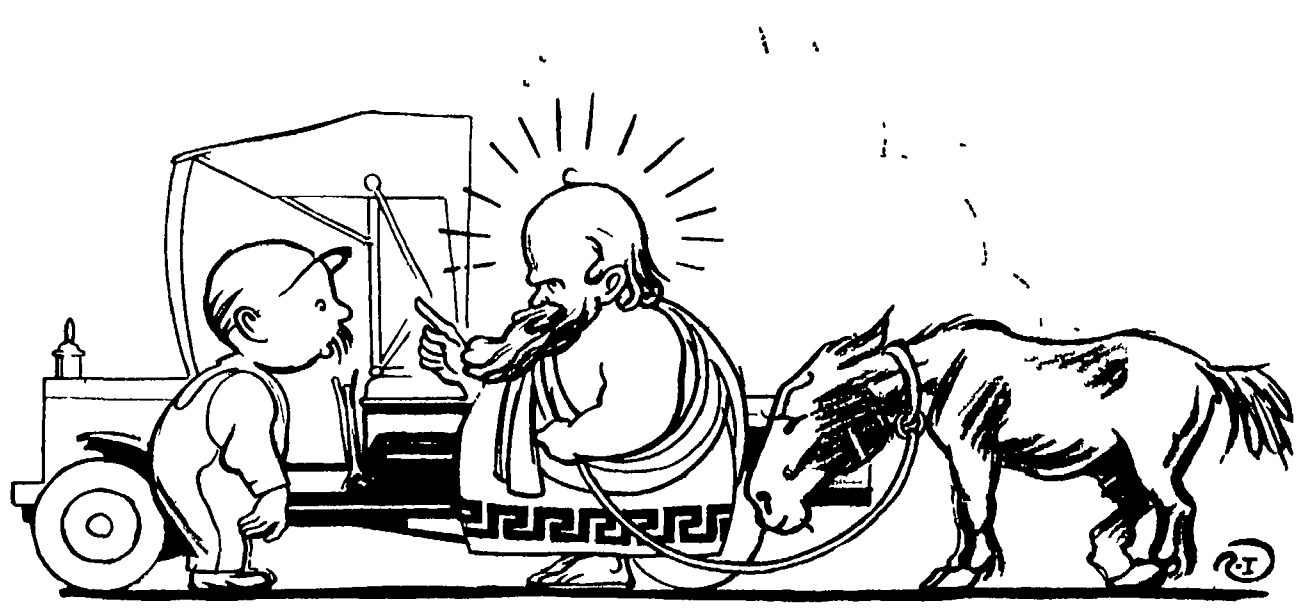

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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV
NUMBER 14

NEW YORK, APRIL 1, 1916

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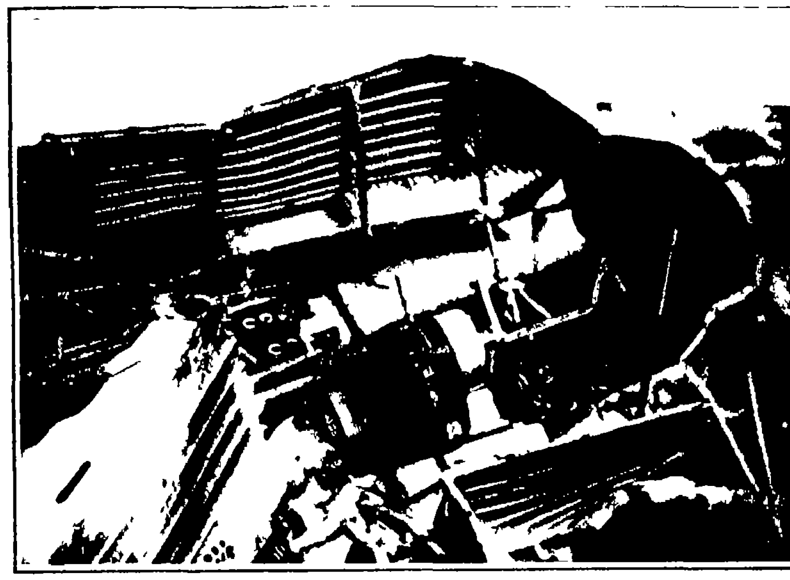
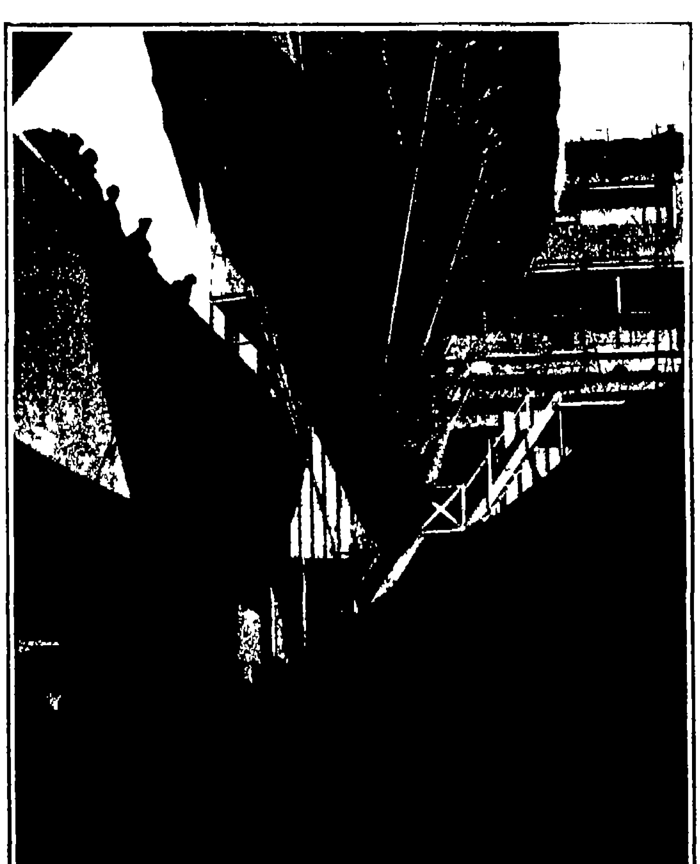
Wreck of a Zeppelin brought down at Brabant le-Roi near Verdun



Nearer view of the Zeppelin wreck showing one of the motors

Austrian infantryman cutting barbed wire entanglements

French miniature train taking provisions to the trenches



Balloon well in H. M. S. Canning, at Saloniki

Kite balloon riding out of the mother ship

Looking down upon the mother ship from the kite balloon

GLIMPSES OF THE VARIED ACTIVITIES OF EUROPE'S FIGHTING MEN

SCIENTIFIC AMERICAN

Founded 1845

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The object of this journal is to record accurately and lucidly the latest scientific mechanical and industrial news of the day As a weekly journal it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns especially when such articles are accompanied by photographs

Our Naval Secretary

ALL is not well with the Navy Of this fact those of us who make a careful study of naval affairs have long been convinced, and to-day the country at large is thinking or saying the same thing We have some of the finest battleships and destroyers afloat, and a personnel that is second to none Having said this, we have said about everything that is to the good, for outside of our ships and men (pitifully inadequate in numbers) there is not much that we can point to with pride, as an exhibit of preparedness and efficiency

There are many weak spots in the Navy Department, and it is a most lamentable and disconcerting fact that one of the weakest of all is to be found in the administrative unfitness of the very head of the Navy—the Secretary himself

With the possible exception of the position of Secretary of State there is no public office that calls for a man of such all round ability experience, breadth of outlook and tactfulness as that of Secretary of the Navy Unfortunately, it is in these very qualities that the present Secretary is lacking And in saying this we would have it clearly understood that we entertain the kindliest feeling and a very sincere respect for Mr Daniels the man He is kindly earnest, hard working, and, we believe, is sincerely desirous of furthering the interests of the Navy—so far as he can do so consistently with his inborn prejudices and his ineradicable conception of the supreme, the imperial demands of political expediency

That Mr Daniels has failed to rise to the magnificent opportunities of his position is rather his misfortune than his fault Doubtless he is as patriotic in the motives which are the mainspring of his administration as he knows how to be If his usefulness has been curtailed and the interests of the Navy have suffered as the result of prejudices born of a somewhat circumscribed environment and a passionate belief in the supreme necessity imposed by party politics—the failure, so far as he is concerned should call more for pity than censure

But alas and alack! This is not a question of the fortunes of one civilian member of the great republic but of the very life and death of that republic itself and if the efficiency of our first line of defense is being impaired by the inefficiency of the gentleman who above all, is responsible for maintaining our naval defenses, there is a distinct call upon his self sacrificial patriotism to bid him step down and make way for a better qualified successor

The present Secretary is hampered by his political obsessions He is more concerned as to whether the Wilson administration is building a greater number of ships than did the Taft administration than he is with the question as to whether we are building enough ships to make the country safe His many past statements bearing upon this question are of record

The present Secretary is hampered by his grossly mistaken impression that there is a breach between the officers and men in the service—a lack of sympathy on the part of the man wearing the shoulder straps for the enlisted man He has said so, not in so many words but by implication as when he suggested that the officers should mess with the men or as when in the matter of abolishing intoxicants from the Navy his voluminous press notices and public speeches were so unbelievably tactless as to cut to the quick the proper professional pride of our naval officers, and run the risk of conveying to the world at large the altogether false impression that hard drinking was prevalent in the mess rooms of our ships.

The present Secretary is hampered and the safety of the country is imperiled by his bitter prejudices on the subject of profits made by private manufacturers of ships armor, guns and naval supplies The attitude of a wise and far seeing Secretary to the private manufacturing concerns of the country should be one of confidence and friendly coöperation The Government is not in the position to supply itself, especially in the event of war, with a sufficiency of these products and, in the nature of things, never will be. Since it will always be largely dependent upon private enterprise, contracts for the Navy should be made attractive, and the Secretary should cultivate the closest relations with the gentlemen whose industry, ability and capital have built up our private yards and gunshops But, as a matter of fact, the present Secretary has treated these gentlemen with a courtesy so scant that it comes very near to contumely His rejection of bids which were made, we believe, in all good faith has resulted in delaying for over fifteen months, the construction of two of ~~our latest battleships~~—this at the very time when the country is imperiled by the relative weakness of its battleship fleet

As revealed elsewhere in this issue, the great engineering societies are just now engaged in mobilizing the private concerns for the defense of the country—how shall this venture succeed if the spirit of Mr Daniels is to pervade the policy and shape the legislation of Congress?

Trademark Legislation

FORTUNATELY for the business interests of the country, every innovation in the trademark law which is proposed by one or another of our transient legislators in Congress assembled, does not become part of the law of the land These bits of potential legislation drop out of a clear sky from any and every quarter Some are elaborate schemes contemplating radical changes in policy More of them are specific amendments relating to details, of hit or miss character often ill considered and calculated to do inestimable harm and little or no good

Of the latter type appears to be a bill recently introduced in the Senate, to amend the trademark law with the object of prohibiting the registration of a trademark which consists in the name of 'any church religious denomination or society, or the name by which any church, religious denomination or society is *commonly known or called* '

Pick up any magazine and turn to the advertising pages One of the first things you are sure to see is an expensive advertisement of *Quaker* Oats To be sure, the proposed amendment is not intended to be retroactive, and would not affect trademarks already registered, but suppose the manufacturers of this cereal were now just applying for registration and the present Statutory Trademark Law had already been amended as proposed, imagine their loss owing to the refusal of the Patent Office to register their trademark and their consequent inability to avail themselves of the protection afforded by the Federal Courts and the additional benefits conferred by the Statute to all of which they are entitled owing to their first adoption and continued use of the trademark in their business.

Many of us use '*Shaker* ' salt upon our tables daily and know the article by no other name, nor do we know the name of the manufacturer Yet this mark also, comes within the prohibition of this law which forbids the registration of any mark which consists of 'the name by which any religious society is *commonly known* '

Again the effect of such a provision is not limited to articles made in this country It applies equally well to goods imported from Europe Perhaps no better established mark is known than that which, dating back several centuries, identifies the cordials distilled by the monks at La Grande 'Chartreuse," prior to their expulsion from France to Spain This 'Chartreuse" mark was unanimously confirmed to the monks by the Circuit Court of Appeals in New York a few years ago Yet under this proposed amendment to the trademark law no such business could again be gathered around the name of a religious organization or church with the sanction of the Federal laws of this country

Here again are international complications, since such a mark may be perfectly good and valid under the laws of France or Spain, for instance, where the goods are made, and yet the mark of origin, well known abroad, could not be protected by registration in this country

This is but a sample of many bits of legislation that are constantly being presented to Congress by our Federal law makers. Most of them find their well merited death at the hands of the "Committee on Patents," to which all legislation relating to Trademarks, Patents, Copyrights, etc, is referred This committee has been, and should be, carefully chosen from among the level-headed, conservative Congressmen, who realize the extent to which the business of the country is built around and upon the good will associated with established trademarks. It behooves the business men of the country to see to it that the wholesome check which this committee affords against hastily prepared and ill-considered legislation be vigorously maintained.

Pan-American Science

ECHOES of the Pan-American Scientific Congress, recently held in Washington, have not been heard so frequently as might have been expected. If the consensus of opinion in regard to the congress could be ascertained, it would probably be that the gathering was a success—with qualifications. The nature of these qualifications is, in part, represented by the heading of an article by Dr William McClellan, vice-president of the American Institute of Electrical Engineers, recently published in the *New York Times* The heading, which is worth quoting, runs thus "Pan-American Congress a Success, Credit Due to Visitors Rather Than to Our Scientific Bodies, Pan-Americanism Still an Undefined Expression."

Without attempting to analyze the text of Dr McClellan's interesting article, we venture to set down a few comments suggested by the phrases above quoted. The Pan American Congress was a success, in the sense that it was fairly well attended, and that the participants derived both pleasure and intellectual profit from it On the other hand, to any one imbued with a love of true internationalism in science, the geographical limits imposed upon the congress were so illogical as to dampen one's enthusiasm for it. There may be sound political and economic reasons for an international gathering confined to representatives of Latin America and the United States, while excluding not only the Old World but also Canada and the other European possessions in this hemisphere, but these have nothing to do with science Again, it would seem natural for the Latin American countries to hold Latin American scientific congresses Above all, it is urgently desirable that the Latin American countries should be more generally represented than they have been in the past in scientific meetings of world wide membership, and in world wide scientific undertakings of all kinds. It is, however, anomalous and inexplicable that the scientific men of Latin America should enter into any sort of union or alliance that includes the United States but does not include Europe Geographical proximity does not explain such an alliance, because the facilities for travel between some countries of South America and Europe are actually better than they are between the same countries and the United States. Identity of political ideals does not explain it, because, in the first place, there are true democracies in Europe and in the second some of the Latin American countries are more oligarchic than democratic The conditions arising from the European war do not explain it because they are only temporary The Pan American Congresses are planned to be a permanent institution The next one is to be held in Peru in 1921

The criticism that the credit for the success of the recent congress is due to our Latin American visitors rather than to our own scientific bodies is—in so far as it is well founded—easily answered The leading scientific bodies of the United States were not consulted when the congress was planned If they had been, the extraordinary blunder of holding the congress in Washington coincidently with the meeting of the American Association for the Advancement of Science in Columbus would have been avoided Moreover, many scientific men who attended the congress gained the impression that the meeting was primarily a political rather than a scientific one, and it is undoubtedly true that the political aspects of the congress overshadowed everything else The keynote was struck at the opening session, when the speeches, nearly all delivered by politicians and diplomats, harped on "preparedness" and the Monroe Doctrine

Finally, as to "Pan Americanism" being an undefined expression, there are many people who believe that it is not so much an undefined expression as the expression of an incongruity, and especially so in its application to intellectual affairs. That cordial relations should be fostered between ourselves and our Latin American neighbors everybody admits. That we should form a closer alliance with Latin America than with Great Britain, France and Germany—or, not to particularize them, with the countries from which chiefly we derive our culture and our traditions—is a proposition from which many politicians and economists would strongly dissent, while to the average man of science it is simply preposterous.

Following the same line of thought, we feel that Dr McClellan's criticism is beside the mark when he contrasts the facility of the Latin-American visitors in English with the inability of our compatriots to speak Spanish. Spanish Americans have, in general, far more need of our language than we have of theirs. This is conspicuously true in science The scientific men of Latin America learn English for the same reason that our scientific men ought to—but too frequently do not—learn French and German, viz., in order to be able to read a large and important body of scientific literature, and to hold intercourse with their colleagues in the countries where science is mostly actively cultivated.

The Army Bills in Congress

IT is appropriate at this time to review the results of the nation wide demand for preparedness as reflected in the attitude of Congress Three measures of great import have been published Senate Bill 4840, House Bill 12766, and the bill for universal training The first two, popularly known as the "Chamberlain Bill" and the "Hay Bill," respectively, command the immediate attention of the people The effect of these measures upon the Regular Army is shown in the following table

	Authorized at present	Chamberlain Bill	Hay Bill
Infantry, Regiments	31	65	41
Cavalry, Regiments	15	25	15
Field Artillery, Regiments	6	21	12
Engineers, Companies	12	48	27
Coast Artillery, Companies	170	263	222
Totals, including auxiliary troops	87,240 to 120,000	178,000 to 248,000	155,000 to 172,000

The difference between the first and second line of totals is due to the system of maintaining skeleton organizations, the second line being the war strength to which the President is authorized to raise the units at his discretion. The Hay Bill provides that the total increase shall be made in four equal yearly increments, the Chamberlain Bill extends the increase over five years Although the Hay Bill contains some sops in the way of providing for training camps and rifle practice, it is so defective in its proposed organization of the Regular Army that it may be dismissed as a measure too amateurish in conception to merit the consideration of thoughtful men.

Except for the skeleton organization, which our ablest officers condemn and have strongly opposed, the Chamberlain Bill, in so far as it affects the Regular Army is worthy of earnest support It provides troops properly organized for seven tactical divisions (troops of all arms in proportions best suited for war, aggregating each about 17 000 peace strength and about 24,000 war strength), for two cavalry divisions (troops of all arms except infantry all mounted and aggregating about 14,000 peace strength and about 20,000 war strength) for coast artillery companies to garrison our foreign forts and to man one half the seacoast guns at home, and for the necessary staff corps. This would permit the stationing of one tactical division in the Philippines, one in Hawaii and one in Panama leaving four tactical divisions and two cavalry divisions in the states The excess (two infantry regiments) over the seven tactical divisions are for service in Alaska and Porto Rico.

That Senator Chamberlain realized the weak point in his bill is evidenced by the change proposed in the enlistment contract. He proposes that a soldier, who by diligence and aptitude shows his fitness, may be furloughed to the reserve after one year with the colors instead of four, thus offering an inducement to enlist for a short term to young men who do not look with favor on four years in the ranks, and also hastening the formation of reserves to fill up the regiments in case of war

And the need for some action is urgent. The reserve clause of the present law is just beginning to be effective, but at the best, under existing conditions, we can hope for only 10,000 men to pass to the reserve each year At that rate it would require seven years to fill up the skeleton companies, troops and batteries But with the changed enlistment law we may feel certain that, at the end of the five years required for the increase, there will be reservists enough to enable our regulars to take the field at full war strength—a quarter of a million trained soldiers. It may be asked what we shall do if attacked in the meantime This has been covered by authorizing the President to make the entire increase at any time war is imminent

The Chamberlain Bill then proceeds to authorize the President to organize and train, at any time, a volunteer force of about 270,000 troops. These are to be United States Volunteers, entirely separated from state control, and governed by the same rules as the volunteers of 1899, who gave so excellent an account of themselves in the Philippines. In other words, a truly federal citizen soldiery The state troops are authorized to join this new force, and this, the General Staff believes, is the only plan, not involving an amendment of our Constitution, which will accomplish the much desired federalization of the militia.

Had Senator Chamberlain stopped there, he would have been deserving of unqualified praise and gratitude. He would have presented the first thoroughly thought-out military legislation ever laid before Congress. Had he included in the bill a provision for the universal training of our boys, he would have fulfilled the cherished desire of our military experts and of an ever-increasing number of our leading citizens.

Unfortunately, he has put in his bill, as a "rider," a militia project which contradicts the principles of the volunteer clause above referred to and which cannot be too strongly condemned Considering the able legislation marking the first part of his bill, this appears to be one of those unhappy compromises which sometimes mar congressional action The portions of the Hay and Chamberlain Bills relating especially to the militia, while differing in detail, are so nearly identical in effect as to indicate the same guiding hand We have all heard of the militia lobby in Washington, and we are forced to the conclusion that it has succeeded, through political pressure, in having adopted a plan not desired by the best and, it is believed, not by the majority, of our militiamen

While the last part of both these bills purports to give the central government greater power to control the troops maintained in the states in fact they can do no such thing Impressed, apparently by an opinion of the Supreme Court, dissented from by our ablest constitutional lawyer Justice Story in a case where the powers of the general government over militiamen who refused to obey a constitutional call of the President was being determined, the framers of this bill have assumed that the decision of the Supreme Court as to the general powers of the federal government might be extended to cover the following, and the bill so provides.

That only certain classes shall be eligible to appoint ment as officers of the National Guard,

That its officers shall be appointed by the President,

That the general government shall prescribe the number of drills,

That the general government can require the National Guard to participate in maneuvers

That the President may prescribe the special units to be maintained in each state, and may require a reserve for each,

That when Congress has authorized the use of the land forces, the National Guard may be required to perform any service within or without the continental limits of the United States

All of the above are desirable, and are necessary to complete federalization but the bill expressly states that the National Guard shall be a division of the militia, and consequently leaves it subject to the political evils of state control For the Constitution has expressly reserved to the states themselves the right "to appoint militia officers," to "train the militia,' and "to govern the militia when not in the service of the United States" The Constitution also definitely prescribes when the general government may call the militia into its service, limiting it to ' repelling invasion," "suppressing insurrection," and "enforcing the law"

Plainly the bill is not constitutional, the first contest cannot fail to show that. The danger in the present situation is that the states will acquiesce in the abridgement of their rights first because the federalization of the militia is recognized as being a desirable thing, and, second, because it is proposed to pay the militiamen from federal funds In this way there will become fastened upon us a system which will endure only so long as those affected desire it to continue Our military strength would be founded on shifting sands. Nay—worse than this State politics have always governed the militia, this bill proposes that state politics shall control our national defenses The influence of state organizations, semi military and semi political, maintained and encouraged by federal funds, will soon become too great to control, and with increased strength will come increased demands, both for preferment and money It is idle to say that the militia has changed As long as the states control, and under our Constitution they must control, the militia, there will be the same inherent defects. The pressure of state influence necessitated the replacement in 1899 of the state volunteers by federal volunteers over whom the central government had full power *An army can be efficient only when there is one commander-in-chief*

It is to be hoped that Congress will neither be deceived nor browbeaten into making this grave mistake when the way is so clearly before it. There are few Americans to-day so blind as not to realize that, for national security, we need five things, all of which must be considered together

First: A strong, well balanced and fully manned Navy,

Second: A standing Army of sufficient strength and so organized as to furnish a reasonable garrison for each of our vulnerable outlying possessions, and to leave at home a force which, in connection with our Navy, will hold an enemy from our vitals for a period sufficient to permit the mobilization of our citizen forces (the Chamberlain Bill provides this)

Third A federal citizen army organized and so trained that three months maneuvers will fit them for war service (the volunteer clause of the Chamberlain Bill provides this)

Fourth A system of universal training of our youth, to cease at the age when they enter business or professional life the training to fit them to give effective service to the nation if it be attacked (the Chamberlain Bill for universal training of the citizen forces provides this)

Fifth The organization of our great resources so that they could be utilized in war under control and without waste

We wish for peace but peace like all other desirable things is to be obtained and assured only by wisdom effort, and sacrifice The organization proposed for the defense of this country in the above program would probably prevent any nation from seriously considering an attack upon us and should we be attacked it would serve to limit initial disaster and give assurance of ultimate victory Incidentally, it would cost no more and probably ultimately less than the political Frankenstein of confusion and inefficiency which threatens this nation in the militia sections of the bills now before our Congress

New Industry Formed Through Supply of South African Talc

TALC or soapstone is now being shipped regularly to Great Britain from South Africa a development in the industry which has taken place since the beginning of the European war The South African talc is being supplied from the Barberton district but it is also found in Rhodesia The *British and South African Export Gazette* states that its discovery is almost a romance, and pays a tribute to the patience and perseverance of the man who was solely responsible for it

For over six years states the journal previously mentioned, the man continued his prospecting work, often in the face of ridicule and more frequently of calumny Thus the early history of the Rand repeats itself To day the man who has developed this industry bids fair rapidly to become a millionaire for French chalk is a commodity that is used in enormous quantities in a multitude of diverse industries and the only limitation to the demand for the South African product will be the difficulty of securing the tonnage South Africa and the motherland will be the richer for what but for the times would rightly be regarded as a sensational discovery of unusual magnitude

The United States however is not only the largest producer but also the largest consumer of talc and soapstone in the world and although producing much more talc than all of the other nations combined, this country imports some of the finer grades from France and Italy The quantity produced in the United States in 1913, as reported by the United States Geological Survey was 149 271 short tons valued at $1 280 020

New York is the leading producer with an output for 1913 of more than 54 per cent of the total production of the United States and far outranking all other states except Vermont which has in recent years greatly increased, having a production in 1912 and 1913 of more than half that of New York Of the total output in 1913, by far the greater portion, 147 529 short tons was sold as ground talc, 238 tons as pencils or blanks for making gas tips etc and 1,504 tons was sold rough as it came from the mine

Method Determining Oil and Resin in Varnish

RESULTS of experiments to find the best method of determining the oil and resin in varnish have been published by the United States Bureau of Standards in Technologic Paper No 65 Several methods are discussed but the conclusion reached by the Bureau is as follows

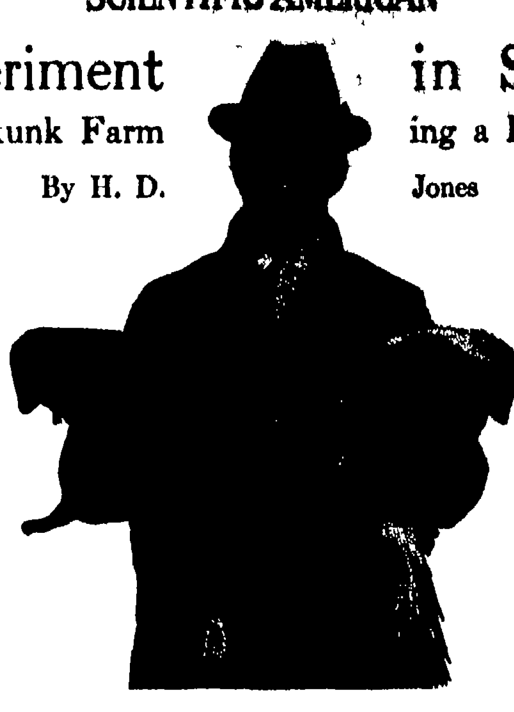
The proposed method for the determination of oil and resin involving esterification by the Twitchell or Wolff methods the use of ether as solvent after esterification and correction of the figures by appropriate factors gave results which were sufficiently accurate for practical purposes and appear to be the best method so far devised for general use

In explaining the situation that led to these experiments, the technologic paper states that in spite of the fact that several methods have been published for the determination of oil and resin in varnish there has been a noticeable lack of information regarding the accuracy of the results obtained due largely to the failure to test the procedures with varnishes of known composition and history It was considered desirable therefore to obtain such information and to devise if possible, a method which would be satisfactory It is shown by the Bureau that several methods to be found in the literature are not reliable for all types of oil varnish.

A Successful Experiment in Skunk Farming

How Two Brothers Found Skunk Farming a Profitable Business Enterprise

By H. D. Jones



A pair of skunks. The one at the left is almost all black

WITH an acre of ground and an outlay of about a hundred dollars, two brothers of Trumbauersville Pa have made a marked success of an experiment in skunk farming Last Fall they sold no less than 700 skunks for breeding purposes to buyers in the West in Canada and in Europe The prices realized averaged eleven dollars for males or females of the first grade and eight dollars for second grade animals The latter were sold mostly for domestic purposes, the skunk being the finest mouser in the world and an affectionate pet when deprived of his objectionable means of offense

The story of the successful experiment with skunk raising as a business is told by the brothers in a most interesting way They had always from boyhood, been fond of trapping in the wild country around their native village, and few holes and corners of the woods in that *part of Bucks County were safe from the trappers and* their dogs At that time they trapped everything trappable, chiefly possums coons minks and musk rats. But the business was a poor one for all the farmers of the vicinity hunted the little animals to death and when coons were placed under the protection of the law and the field became still more limited it scarcely paid to stay out all night after the little fur bearing animals for the sake of the small amount paid for the pelts

But one day inspiration came to the trappers through the capture of an unusual bag of skunks The brothers carried home no less than seven of this fur bearing animal All were females and this gave them their big idea They decided to cage the seven skunks and hope *for interesting developments in the future* Their hopes were abundantly realized, for every one of the seven captured skunks turned out to be a prize The first to prove the good fortune of the trappers presented them with seven little skunks at a litter and the other six came nobly to the mark until the seven skunks trapped in the winter had increased by the spring to thirty seven

With this substantial colony as a beginning the brothers started *their farm* They now keep about 200 skunks in the pens, adding to the captive breeders from time to time by excursions to the neighboring woods for fresh stock

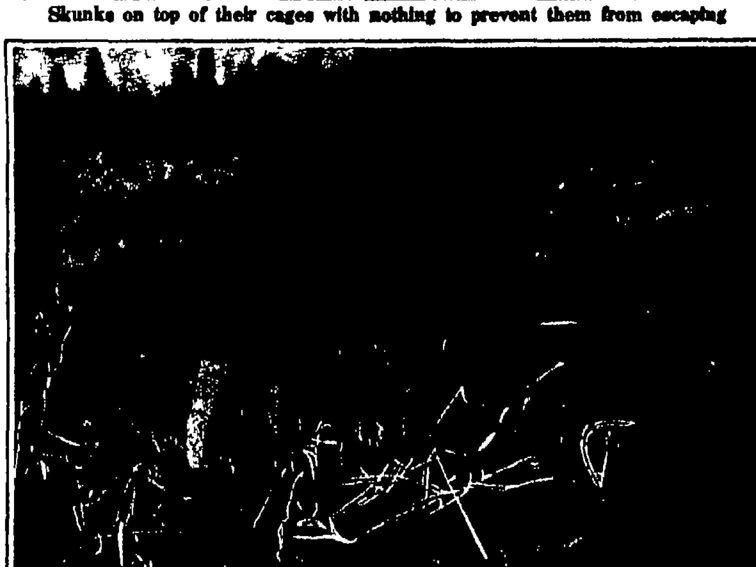
The pens were easily made The brothers bought six bales of inch mesh wire at $15 a bale boarded the floors and made the pens water proof by tar roofs Thus were the skunks provided for for all kinds of weather

In the early days they lost a few of the animals from illness due to ignorance of the proper kind of feed for them, but more from boys of the neighborhood who raided the pens at night until the skunk breeders caught on to the fact that the animals were not digging their way to freedom in some mysterious manner, as was thought but were being assisted out of captivity by two legged depredators Since this truth dawned upon the brothers and they were able to take proper precautions to guard against it there has been very little loss

Care had to be taken to keep the animals properly fed, for if hungry they would not hesitate to attack each other If left for a long time without food it would be a case of the survival of the fittest in the pens, for the skunks are cannibals of the worst kind and do not hesitate to kill and eat their own immediate relatives if driven to it by hunger

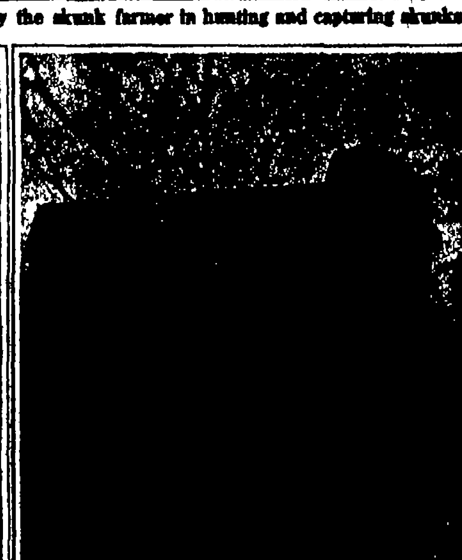
Occasionally the skunk breeders found they had trapped a Tartar in the shape of a fierce and vindictive male who would live at peace with no one There was never any choice but to get rid of one of these fighters for every skunk in the same pen would be chewed up in the struggle that followed his introduction to what had previously been a peaceful and contented family As wounds on the animal spoil the fur, which is too small to permit of much scarring of this sort, it was found wise to watch newcomers carefully when a skunk fresh from the wilds was introduced to the colony If he showed fight at the start he was promptly banished to the woods from whence he came, or his pelt left hanging in the drying shed.

Skunks on top of their cages with nothing to prevent them from escaping



The trained dogs employed by the skunk farmer in hunting and capturing skunks

Method of holding skunks—by their tails



A black-and-white marked skunk, showing the beauty of the fur

Early in the three years' experiment that the brothers have been conducting it was found that the profits of skunk farming lay not so much in the sale of the pelts as in the sale of the animals themselves for breeding purposes. The increasing demand for skunk skin for purposes of feminine adornment and protection induced many persons throughout the country to start skunk farms, and the establishment of these farms made it possible for the breeders to derive a brisk trade in the animals themselves. As the skins had not been selling for very high prices, this departure in the business was the beginning of a satisfactory return for the breeders.

The skins that are most valuable for marketable purposes are those that are free from white marks. The brothers found the scarcity of black furred skunks one of the most formidable obstacles in their way when they first started the breeding business. The animals trapped were for the most part strongly marked with white and these were so unpopular with the pelt dealers that it was not possible to get more than 25 cents for the very heavily marked, while $2 25 was the highest price paid for skins that showed but a little trace of the white marking

So the brothers set to work to eliminate this particular obstacle by careful breeding Selecting the nearest to all black animals they could procure, by trapping, or which came into their possession by the births in the captive colony, they bred these, and in time they have succeeded in obtaining an animal that is almost all black—the only white markings are on the tips of the ears, these being so obscure that the skins would almost sell for totally black. But the skunk breeders are not yet satisfied they are determined to procure an animal that has not the slightest trace of white in its fur So confident are they of their ability to do this that they declare it will be an accomplished fact in a very few months.

Meanwhile they have found a market for the marked skunks by creating a demand for them as pets For this purpose they are preferable to the all black skunks, for, as can be gathered from the accompanying illustrations, the white and black animals are very prettily marked When there is added to their pretty appearance the affectionate disposition of the animal when it comes to know its owner, and the fact that it is death to all kinds of household pests, its value in domesticity can be estimated. For the white and black skunks sold separately as household pets the two skunk farmers have been getting eight dollars each. This is a sort of side line with them for the farmers and boys in the vicinity trap the skunks and sell them to the brothers for five dollars each. After a little simple operation for the removal of the scent sacs the brothers can then sell them at a handsome profit. There is a steady demand for these "safe" skunks, both from city dwellers and from farmers and others who want them around the house and the barns to keep vermin away.

According to the breeders, there is little fear that a skunk kept around a farm will kill the chickens. It certainly will if it is not fed properly, but according to these experts the skunk that is fed regularly by its owner will not trouble the poultry; rather it will keep to the house and only roam around at night in search of rats, mice and insects.

The brothers estimate the cost of keeping a colony of 50 skunks for a year to be about $160. The food they eat and thrive on is largely the remains of the family meals, meat and vegetables. A scientific investigation of the [illegible] of

(Concluded on page [illegible])

A Cinematograph Screen That Does Not Need Darkness

ACCORDING to the latest statistics, nearly 16,000,000 people frequent daily the "movie" shows here in the United States. And there are fully 18,000 of these showplaces in operation. Darkness is essential to successful display, and this needful gloom has been abused more or less seriously. To avoid these consequences the laws of some states require that the picture theaters be illumined every 15 minutes during the show. The reels are highly inflammable, and panics occasioned by their conflagration have more than once caused grave loss of life.

But now, thanks to the successful development of a satisfactory translucent screen, it is not only possible to greatly lessen the hazards incident to a darkened showplace of this sort, but daylight movies are practicable. In other words, with the screen invented and developed by John F. R. Troeger, pictures can be projected without the usual enveloping gloom. The hall can be fully illuminated. Instead of placing the projecting lantern in the theater and among the spectators, the translucent screen makes it feasible to locate this apparatus back of the theater and in a fireproof room—a single opening in the intervening wall sufficing for the projecting rays to reach the screen in front of it. Should anything go wrong with the lantern, there would be nothing to alarm the audience.

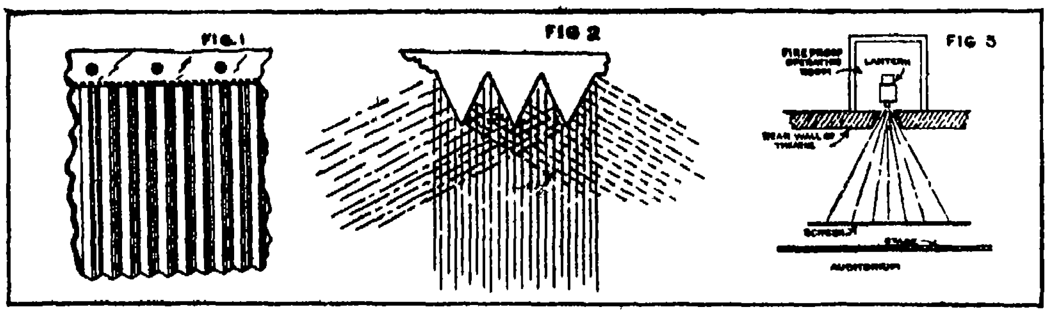
This fireproof screen, because the light rays pass on directly to the spectators and because of the nearness of the projector to the screen, permits of a very high illumination of the image, contrary to the usual white screen and the more remote lantern. Further, because the surrounding atmosphere is lighted up the eyes are not taxed by the contrast between the ordinary darkened hall and the more or less dazzling white screen. Besides this, the spectator gets a more realistic picture and one with but little distortion, no matter where he may sit in the house. This is due to the texture of the surface of the Troeger screen.

The front of this screen is marked vertically by very fine ribs or prisms, and these serve to show the picture with but little lateral foreshortening, even when the point of view is well off to right or left. The pictures besides, are truer to Nature than the photographs on the films. That is to say, they have more depth and are not marked by that "flatness" so common to most motion picture displays.

The camera is a one-eyed instrument, and two eyes are necessary to get the double image which produces the sense of depth. The projecting apparatus ordinarily simply reproduces the flat photograph. But the ribs on the Troeger screen give our two eyes the duplex images we are accustomed to, and thus we get the so-called stereoscopic effect which nature intends we shall have when viewing any object that has form and not flatness.

For educational purposes a translucent screen of this character is much to be desired, because it permits the lecturer to see his audience and thus to promote sympathy. At the same time, the spectator's attention is apt to be far more constant, and there is less likelihood of the eyes being tired or of a hypnotic effect induced by glare.

A model of the new motion picture screen in which the projector is placed in the rear



Features and principles involved in the new motion picture screen

Fig 1.—Corrugated surface of the screen. Fig. 2.—Illustrating the broad principle upon which the ribs or prisms cast the picture rays directly ahead and on both sides. Fig 3.—General plan of a thoroughly safe motion picture installation made possible by the translucent screen

Testing the Tensile Strength of Different Materials

THE accompanying illustrations are of particular interest in that they clearly show how a glass cube is shattered when subjected to excessive pressure and also the effects of an excessive load on a steel cable.

The three illustrations of the glass cube show the article before and after the test. The cube measured 10 inches on all sides and withstood a pressure of 2,000,000 pounds or 20,000 pounds per square inch. The cube as it appeared after the test is shown in two views, one of which shows the remarkable shattering effect of the pressure. Cubes of this kind are used as insulators for masts of wireless stations and must support several tons weight.

The remaining illustration represents a 3¼ inch steel cable, one strand of which failed when a load of 937,000 pounds was applied to the cable.

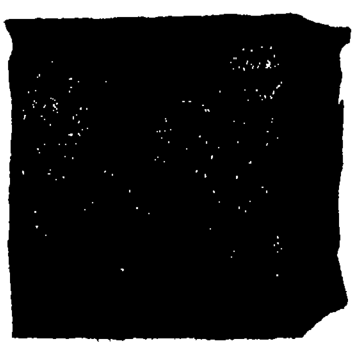
The tests were made on the large Emery testing machine at the Bureau of Standards, Washington, D. C.

Exposition of Artificial Limbs and Equipment for Manufacturing Them

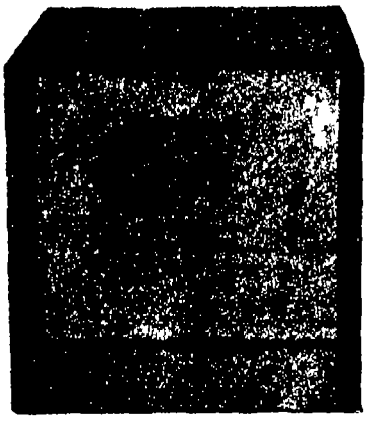
THE Russian Embassy at Washington announces that a prosthesis exposition is being held at Petrograd this month. In connection with the exposition there will be a competition of inventions and appliances in the making of artificial limbs. The prizes will consist of money awards and will be of different classes. Space will be given free of charge at the exposition and exhibits will be allowed to enter Russia free of duty.

The Current Supplement

THE same conditions that are bringing industrial prosperity to this country are also tending to increase prices—not that the reasons are applicable in the case of most food supplies, but because the wily merchant seizes upon the increased prices of war materials as a pretext for boosting the price on everything else. Such being the conditions, however, the article on *Food Selection*, for rational and economic living, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No. 2100, for April 1st, 1916, will be of universal interest. *High Explosive Shells* is another article that is timely, for it describes and illustrates the construction of the various kinds of ammunition that is being used by the Allies in the terrific artillery duels that are so constantly being fought in Europe. *Photochemistry* deals with researches in relation to the chemical reactions caused by the action of light. This issue contains another of the series of articles on *Some Noted Zoological Parks*, the subject of this instalment being a description, with numerous illustrations, of the National Zoological Park, at Washington. The valuable paper on *Light and Illumination* is concluded. *Finding Your Way at Night Without a Compass* will appeal to every soldier, explorer and traveler in unsettled regions, and also to many others. It is illustrated by a number of diagrams. *Flame Standards in Photometry* deals with the necessity for a reliable basis for measurements of light, the conditions to be met and facts relating to the lamps used in an extended investigation. Other articles of interest in this issue include *Jupiter—The Solar King*, *Sources and Collection of Rubber*, *Turbine Blading* and a discussion of *The Phenomena of a Moving Automobile Wheel*.



View of the glass cube after being subjected to a pressure of 2,000,000 pounds

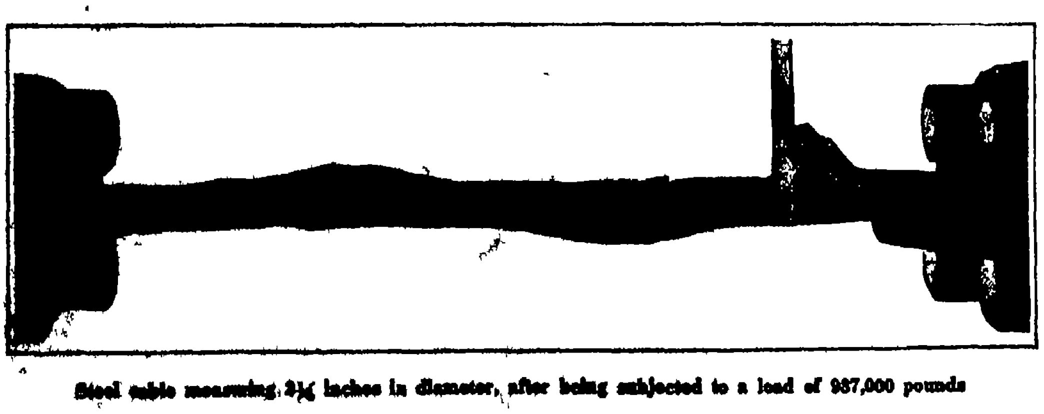


Glass cube before being subjected to pressure test. It measures ten inches square

Another view of the glass cube after the pressure test, showing the shattering effect

"Rondonia"

IT is proposed to give this name to the region of Brazil lying between the Juruena and Madeira rivers in honor of Col. Rondon, who was associated with Mr. Roosevelt in his famous journey down the "River of Doubt," and has done so much other admirable work in exploring and building a telegraph line through the Brazilian wilderness. The new name for the region is a most acceptable one.



Steel cable measuring 3¼ inches in diameter, after being subjected to a load of 937,000 pounds

Naval Consulting Board's Committee on Industrial Preparedness—I

The Comprehensive Plan for Mobilizing the Nation's Industries for War

A RECENT talk by a member of our staff with Mr Howard E Coffin, Chairman of the Committee on Industrial Preparedness of the Naval Consulting Board, enables us to present the following summary of the plan and scope of the work of this committee

It was realized at the very outset that the problem of naval and military preparedness resolved itself into the military and the industrial sides and that as the military side was very efficiently taken care of by the men at the heads of the departments of the Army and Navy so the industrial side, when it came to the question of the mobilization of the industrial strength of the country was that with which the members of Mr Coffin's Committee on Industrial Preparedness was immediately concerned and for which it was specially qualified In the opinion of the chairman the course of the European War during the past twenty months has entirely upset our preconceived notions of warfare, and the problem has very largely settled down to a question as to which of two combatant nations can fastest and for the greatest length of time feed the necessary supply of munitions to the men on the fighting line Side by side with the mobilization of the professional fighting men we have seen the mobilization of the men, women and children of the nation in the production of some one or other of the multitudinous supplies which must flow without let or hindrance to the armies at the front The question of ultimate military success is one not merely of the ability of the professional fighting men of the Army and Navy, but of the ability of the industrial brains and the skilled hands of the whole citizenry of the country If the nation is thus to back up the Army, the work must be largely done in the time of peace—we cannot wait until the thunderbolt of war strikes

The work of the committee has naturally resolved itself into three stages The first is to determine exactly what the country can accomplish in making munitions the second is so to apply that knowledge that the whole of the manufacturing plants can be put at the service of the Government and the third is so to organize skilled labor that such of it as is required will be retained in the various industries and not rushed away to the front as happened so disastrously in the allied countries during the early months of the war "From the way things have been shaping themselves during this war," said Mr Coffin "it looks as though the skilled mechanic of the future will win the wars of his country, and that the banker, if you like and the lawyer will be merely the men who will carry the gun to the front, there to serve the useful purpose of cannon fodder"

In laying out its plan of campaign the Committee on Industrial Preparedness realized that the work of tabulation and administration would have to be in the hands of the engineers of the country In answer to a letter of President Wilson to the presidents of the leading technical organizations of this country namely, the mining civil, mechanical, electrical and chemical engineers' societies, a member of each society in every state in the Union was formed into a board of directors, which provided a board of directors of five men in each state Serving under them are thirty thousand of the skilled engineers of this country The first work to be done by these engineers will be to collect complete data as to the industries of the country This will be done by means of printed forms in accordance with the procedure and practice of the United States Census Office The census will affect from thirty to thirty five thousand concerns, and it will secure from them a business inventory of the character which any business man would require regarding any concern with which he is going to enter into business relations Each form will have filled in the name of some concern regarding which information is sought and it will be passed on by the state directors to the field engineer who is assigned to gather data regarding that particular plant

Very considerable impetus will be given to this movement by the hearty coöperation of the National Chamber of Commerce which has addressed a referendum to the chambers of commerce throughout the United States which includes resolutions that coincide very closely with the program of the Committee on Industrial Preparedness When the inventory which will be made probably during the month of May is complete, the next task will be to get the industries which have been enumerated into such shape that they can efficiently do the work required Mr Coffin states that there is not a manufacturer in this country who can start on quantity production of shells within one year after the receipt of an order, unless he has previously done shell work in his plant—in other words, the manufacturers have to be educated in the production of munitions, and this in times of peace. War time demands are such that it will be impossible to provide sufficient government owned plants to meet them A certain number of Government plants we must have, and they should be scattered through the country They should act as educational centers and clearing houses for specifications and blue prints, but in any future war of magnitude it is upon privately owned plants that we should have to depend It would be a positive calamity if legislation in Congress this year should merely create a larger Army and Navy and a few munition plants, and then settle down under the conviction that the country is prepared.

As at present determined, it is proposed to give small annual orders for munitions to each of the selected plants, said munitions to be made according to Government specifications at such time in the year as may be convenient Everything connected with this order will be done exactly as it would be were the order a war order of one hundred times the magnitude The work will be educational The purchasing department of the company will learn where to buy materials, the manufacturing department how to handle them, and make the necessary jigs and tools, equipment etc , the inspection department will become familiar with government inspection the engineering department will become familiar with Government blue prints and specifications the firm will become familiar with governmental methods of business and the shipping department will know how to crate and ship the finished article

An important phase of the work of the committee is the labor question, as affected by the proposed organization, which will insure against shutting down of plants, and will guarantee employment to the maximum number of men even when war is being waged The ground will be cut from under the people who are forever finding out that there is a munition lobby at Washington for it is proposed that the Government shall place orders upon some such basis as that of cost of production plus a reasonable and agreed upon profit and with this understood and with the further understanding by the mechanic that he is defending his country just as surely and honorably when he tends a lathe, swings a sledge or pours the hot metal into the mold, as if he were behind a machine gun or rifle in the trenches, the skilled labor of the country will rally to the cause of National Preparedness

The question of the quantity manufacture of war supplies is an intricate and complicated one, and full of surprises Absolutely fundamental to such work is the provision of an enormous number of measuring tools and gages—a very special line of manufacture in which only three concerns are actively engaged at the present time, namely, the Pratt & Whitney, the Brown & Sharp and the Greenfield concern. These three have found in comparing estimates that to produce two hundred thousand shells per day, which is the amount under contract for the Allies at the present time, would require in gages and measuring tools alone an investment of from seventeen to twenty million dollars. The delay in the delivery of American made ammunition to the Allies has been due largely to the lack of these gages It is impossible to state the average time consumed by American concerns in producing the machinery and tools necessary to commence production on foreign orders, but many of the best known factories in the United States have been at work a year on the problem without producing sufficient finished product to be worth inspection So much specialized knowledge and skill is necessary in producing war supplies, and particularly munitions of war, that it may be said to be a new art, and before the vast facilities of the United States can begin to wrestle with the problem of taking up this new art on an extended scale, it is necessary to start at once and well in advance of any possible conflict, a thorough and widespread system of education

As showing the extremely special character of the work which is called for in producing implements of war, Mr Coffin instanced certain testimony given before a special board in Washington, during which, in speaking of the modern military rifle, the expert witness stated that in the manufacture of the new model Springfield rifle the receiver alone, which contains the bolt and firing mechanism, requires 120 separate and distinct operations before it is finished, which means that 120 gages must be prepared before this part of the rifle can be made Furthermore, these gages, because of the wear due to abrasion, can be used only for from 8,000 to 10,000 gagings—they must then be scrapped.

Mr Coffin is of the opinion that as the result of the placing of orders for munitions for our Army and Navy among the large number of firms that will be selected throughout the country, there will be a valuable return to the Government in the way of useful suggestions by the engineers of the various works for the simplification and improvement of the plans and specifications

The Magnetic Hand

NEXT to the irreparable loss of an eye, doubtless the loss of a hand is the most serious affliction that can befall a man, particularly if the person thus mutilated be dependent upon some handicraft for his livelihood The artificial limb makers have done much to restore symmetry of appearance in such cases, and even to enable the victim to perform the ordinary activities incident to daily life and certain forms of work by means of suitable prosthetic apparatus But it has remained for the electro-technical engineer to provide him with a substitute which is not only capable of grasping and holding, primary functions of the hand, but supplies a strength equal to or in excess of that which inhered in the missing member

At a recent meeting of a committee of the Union of German Electrotechnicians, Dr G Klingenberg urged that the Union endeavor to extend the use of electromagnetic apparatus for crippled workingmen, particularly those in all the iron trades, and in a late number of the *Zeitschrift des Vereines des Deutscher Ingenieure* he describes such a device. The sheath which holds the arm stump is attached to an electromagnet instead of to an ordinary artificial hand or to a prosthetic tool holder This magnet is bell-shaped and mounted on ball bearings (kugelig gelagert) so that its grasping surface is adjustable to any position desired It is capable of being fixed firmly or may remain movable with a slight degree of resistance Thus it obviously simulates the flexibility of the human wrist. It is connected with the necessary source of current by means of contact plugs (Steckers), and is thrown into the circuit by a motion of the sound arm, of the foot, of the chin, of the whole body, or of the stump of the injured limb itself. It is then capable of grasping, lifting, and moving any article made of iron or having an iron plate suitably attached And since the coupling is flexible, the workman is capable of handling a great variety of tools, which as a rule do not even require to be specially modified, since the magnetic hand is capable of grasping the instrument in any required position If, for example, a file is to be used it is placed near the point of the latter and clings there as soon as the current is on. Carpenters' tools, such as a plane, are provided with a suitable iron plate to provide a grasping surface A stamper at a stamping machine (Stanzer) can handle his work even better than with the natural hand, since the sheet to be stamped can be grasped by the smooth upper surface The strength of attachment may be graduated to almost any desired degree by using magnets of different sizes. Various modifications permit special forms of grasp as required, e g, by pincers or tongs (Zange) It is even possible by a combination of magnets to produce the action of the elbow joint, of the thumb, and of the four fingers of an artificial hand.

While this instrument is chiefly intended for use in large plants where it is easy to obtain the necessary current, sufficient power for the ordinary movements of the limbs can readily be secured by means of a portable battery Dr Klingenberg urges artificial limb makers to avail themselves of electromagnetic power by this and other devices, and also emphasizes the importance of action to prevent individual patents from monopolizing such devices to the disadvantage of the public welfare.

Discovery of New Asbestos in the Transvaal

THE recent discovery of fibrous asbestos occurring in South African rock formations in which asbestos has not heretofore been found, is reported by the American Consul stationed at Johannesburg. It is of a new and superior character, and one which, it is thought, may have an important bearing on the asbestos industry It is said that the available quantity is considerable, that it is of a new color, mostly golden brown, of a greater length than any mineral fibre previously known, and of good weaving strength.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

South American Trade

To the Editor of the SCIENTIFIC AMERICAN:

A great deal has been said and written about capturing the South American trade from the Europeans, but how much has actually been done will be seen in a very short time after the war is over. We have had 18 months with a clear field but later we will be up against every kind of obstacle both as regards trading and shipping. The Germans, British, French and Italians know the South American trade from A to Z, and having established the strongest banks all over the republics, and having the assistance of subsidized ships, they will be in a position to return with fresh vigor and fight to the last ditch in the way of undercutting prices of goods and steamer rates. The most important link in the chain is undoubtedly the strong banks already established there. London, Berlin, Paris and Rome have old established branches which cover practically the whole of Brazil, Argentina and Chile, and after many years of trading they know almost to a dollar how much credit to allow every customer. Is it likely that our newly formed banks can find out a firm's credit from the foreign banking houses? Not much. This knowledge can very often only be gained by dear experience and lessons. Also these banks have become accustomed to give their customers very long credits which is a thing we have in the past flatly refused to do. With us it has been a case of Here are the goods, where is the money? It must also be remembered that the largest South American republics have been very heavy borrowers from England, Germany and France for many years and their governments have many loans still to pay off, also most of these countries have a fluctuating exchange which make it very necessary for an importer and exporter to study every detail of the countries' politics, crops and financial ups and downs in order to carry on his business without severe losses. Nearly all the big European banks and trading houses have their clerks in specially healthy localities and have excellent quarters for them and in this way the clerks are all together and can assist one another both in the office and in their recreations. The majority of the European firms are old established or new firms that have bought out old ones. These companies know all the little fancies of different customers, their native and home clerks have in many cases been with them for years and it is one of the surprises of South American business firms to see how long they keep their employees. One of the principal reasons for this is that the foreign firms pay good wages and look after the welfare of all their clerks. These employees know the language and customs of their customers, many of whom are large coffee Tazendeiros in Brazil, cattlemen and grain men in the Argentine and nitrate of soda mine men in Chile. These customers are very large employers of cheap labor and they buy immense quantities of every conceivable kind of supplies and their credits are good for long time notes. Again all these importing houses have most of their head clerks out from the home office and they are all taught Spanish and Portuguese thoroughly before they arrive in the country. Extreme tact is needed to deal with the South Americans. They are the most polite people I have ever met. Politeness comes next to religion with them and it takes hours and sometimes days of patient attention and waiting on some of them to gain their goodwill, confidence and trade. One of the first words for anyone trading there is to thoroughly understand the Portuguese word Amanhã, which means to-morrow and is generally used and means don't hurry me, I want time to make up my mind. It must not be forgotten that although the people of the cities are very lavish spenders, the bulk of the laboring classes are very poorly paid, as almost all the outside laborers of the interior are given small wages and a piece of land and sometimes a small share of profits, so it comes to be a case that about 75 per cent of the imported articles must be cheap and attractive. This is the reason that Germany has made such inroads into British trade. Britain made a good solid article built to last and Germany made an attractive cheap article which appealed to the low paid workers of the country. It has long been one of the principal drawbacks to American trade that our manufacturers and travelers did not thoroughly understand the language of the country, also in many cases the different business and credit methods of each. It is no use for a man to take a few lessons in Spanish and Portuguese and go down there and try to sell them goods for cash when they know they can go to their own traders and buy exactly the same American goods from the German and British on long credits through the banks who have trusted them for years. The South American business man is extremely sensitive and honest and it takes many months of patient labor to find out each customer's whims. If we are going after this trade it is high time we taught Spanish and Portuguese in all our high schools. Not many of our thousands of high school graduates know a single word of the above languages and once the boy leaves school he has missed his finest chance of learning a language. The future market of the world is South America and it is absolutely necessary to learn both Portuguese and Spanish as Spanish is useless in Brazil and Portuguese is of as little use in the other Spanish speaking countries. When the South American has a little money to spend he takes his family to Paris, London, Berlin and Rome where he has his exclusive clubs and hotels and they spend thousands of dollars and are very often well entertained by the European side of the firms they trade with. It is all very well for our Government to make protective alliances with these republics but that will not help trade. Trade has to be gone after and worked up and then held against the strongest competition.

I see that a company has been formed in New York and Boston with a capital of $10,000,000. Now if the Government would only pay a bonus for every ton of exports and a small bonus for every ton of imports to and from South America carried in American bottoms it would give our steamer men some encouragement without some help it seems almost hopeless. At present things look pretty good, but one of the principal difficulties is to obtain a full cargo both ways. Can we do that? At present we can, but after the war when the steamship lines once more become thoroughly organized (and do not let us imagine it will be any half measures) they will be more thorough than ever before. All the European countries have their large fast passenger steamers that are floating palaces. They are smaller than the liners coming to New York but in many cases have far superior accommodations. Then these lines have another fleet consisting of slower large capacity cargo boats some of which carry a few passengers at lower rates. Then the British and Germans have small shallow steamers that go up the large rivers and dodge along the coasts and pick up cargoes for the larger steamers. These steamship companies had a pretty good understanding between themselves before the war and even though there is war between them now it is highly probable those rings will be renewed to a certain extent. In many cases cargo tramp steamers are chartered for a load of coal or goods from Europe to South American ports, then load up with a full cargo of coffee, hides or nitrate of soda for a United States port, then load with grain for Europe. I notice that nearly every American steamer has gone into the European trade and sailing vessels into the South American trade. Would it not have been more profitable ultimately to have paid more attention to South America and have had American steamers carrying cargoes from South American ports instead of having almost daily arrivals at our ports of British tramp steamers with full cargoes from Chile, Argentina and Brazil in spite of the fact that England is at war? It looks as if England for one intended to hold on to her trade in the South. Let us make our start at once or we may hang up the sign "*Too Late*."

E. ANDERSSON.

Sebago Lake, Maine.

Durable Lead Coating of Iron and Steel

To the Editor of the SCIENTIFIC AMERICAN:

A letter received by me from the United States Consul at Bolivia and Peru, Mr. Donaldson, says that the Great Northern Railroad Company and the fruit, etc. shipping companies there complain of the speedy destruction of galvanized roofing sheets on their buildings. In your supplement issue of January 1st, No. 2087, Mr. H. B. C. Allison gives among other processes of covering iron and steel goods, sheets, etc., the Lohmann process, it being a supposed good lead sheet for roofing purposes. Lead covering (*pure lead*) would be the ideal sheet for that market in South America. Mr. Allison describes the Lohmann process fully, and it says, that after cleaning the sheets, the sheets are put in a bath containing hydrochloric mercurial and ammonia. The metal bath consists of *alloy metals*, now it has been found in tropical countries, near the sea coasts particularly, that any roofing sheets having *a mixture* of metals covering or spelter zinc itself *that any metals but pure lead* is soon oxidized. Having spent most of my life, as a coater of iron and steel, I know from reports from different sources that this is correct. Anyone interested in the *pure lead coating*, may please correspond with

D. R. JENKINS.

Youngstown, O.

A Billion Dollars!

To the Editor of the SCIENTIFIC AMERICAN:

A billion is a thousand millions, but this definition does not give a satisfactory conception of its magnitude, and it is necessary to find some way to make it clearer for it, before this world's war a million dollars was spoken of only with awe, a billion dollars has to-day at a jump become an everyday expression in modern financial topics.

They say the earth is 93 million miles from the sun, but we understand much better when we are told that the earth is distant 11,500 earth diameters from the sun, this unit of 8,000 miles (the earth diameter) being nearer to us.

Hence let us try a kind of qualitative and quantitative analysis of a billion dollars by measuring it in time, weight and labor.

As to time.

In the year of our Lord 1901, on the 29th of April at 5 h. 20 m. A.M., we would have completed a billion dollars if, at each and every minute a dollar had been struck and added to the pile until that date.

The length of the astronomical or solar year being taken as 365 days, 5 hours, 48 minutes and 48 seconds it gives a year of 525,948.8 minutes.

		Minutes
525,948.8 min. × 1901 years	=	999,302,720
1 year (calendar year of 365 days)	=	525,600
1,440 min. (24 × 60) × 119 days	=	171,360
60 min. × 5 hours		300
	and	20
		1,000,000,000

As to weight in gold.

A gold dollar weighs 25.8 grains, hence

$$\frac{25.8 \times 1,000,000,000}{7,000} = 3,685,714 \text{ pounds avoirdupois or}$$

1,645 long tons, a gold train of some 100 freight cars.

As to work.

It represents 200 millions working-days at $5.00 per day.

EDMUND BECKER.

Washington, D. C.

Experiments in Use of Niter Cake

IN the search for a substitute for sulfuric acid several of the mills in Yorkshire, England, have carried out a number of experiments in the use of niter cake. The purpose is to employ it in various operations in which sulfuric acid is ordinarily used. The *Yorkshire Post*, of Leeds, says that from the results of these experiments which have all been made on a working scale it is evident that niter cake can be used in place of ordinary sulfuric acid for the extraction of grease from either wool suds or piece-scouring suds, for the refining of grease, for the stripping of rags, except perhaps where light dyes are subsequently to be used, and for dyeing rags in the shoddy trade, more especially where dark colors are being used.

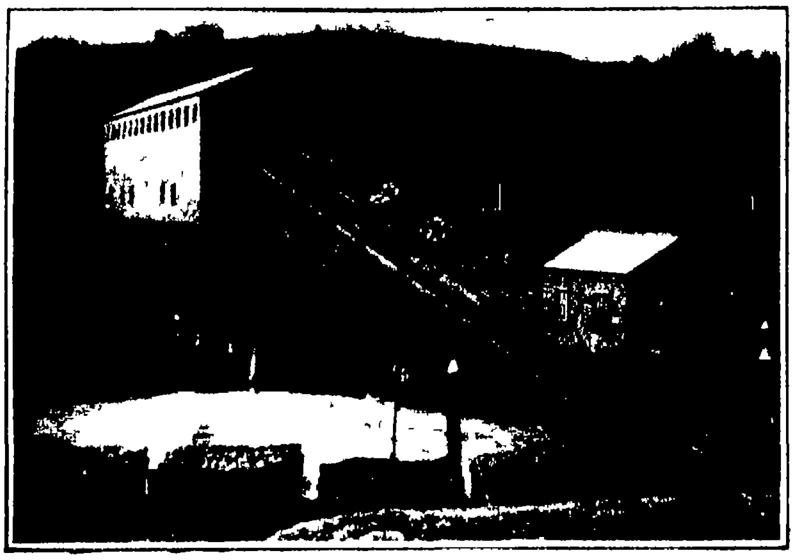
The *Post* states that certain difficulties in the use of the cake are presented, but that these can be surmounted. They are chiefly difficulty in handling because in larger quantities as the cake contains only 30 per cent of its weight of pure sulfuric acid, draining of the acid liquid in storage and handling, and difficulty in transportation. It states that the best method of using the cake is to dissolve it in hot water by the aid of steam, and to use this solution while still hot.

New Apparatus for Controlling a Ship from the Bridge

DR. K. ITO, manager of the engine works of the Mitsu Bishi Dockyard and Engine Works at Nagasaki, Japan, has invented an apparatus for controlling the movements of a ship directly from the bridge, so states the *Commerce Reports*. This invention is likely to have the most far reaching results and will undoubtedly be adopted by shipping companies in all parts of the world. The device does away with the necessity of telegraphing instructions to the engine-room. The new apparatus which enables the officer on the bridge to regulate the valves or reverse the engines directly can move the ship at will in the time it usually takes the engineer to receive the message by means of the telegraph indicator.

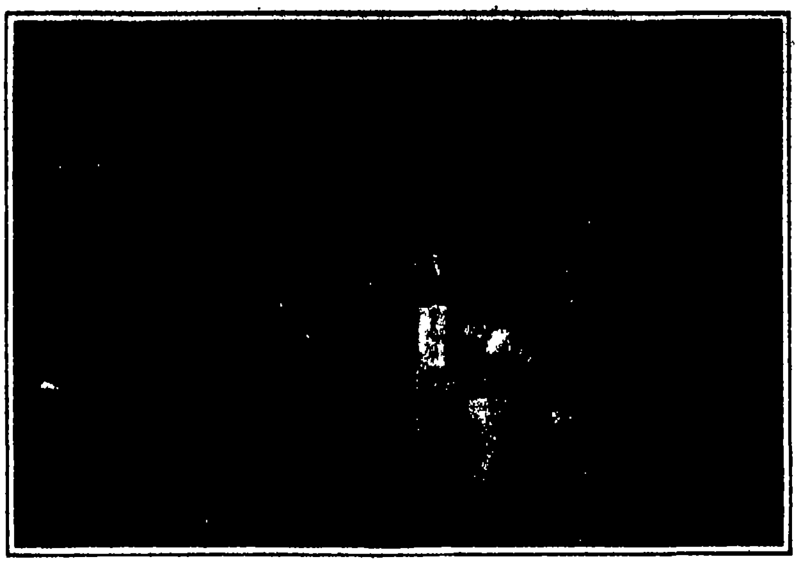
The new apparatus prevents the possibility of misunderstanding and error. In case of accident, disputes frequently occur between the bridge and engine-room as to the indication of the engine telegraph. The device may be used with great advantage in foggy weather or in going in and out of a harbor or in anchoring. The greater mobility which a ship thus attains will often enable it to avoid a collision. The racing of propellers in stormy weather frequently causes great damage to the engines. This however is said to be prevented by the new apparatus. The navigator can adjust the engines instantly before the big waves are encountered.

Unfortunately details of the new device are not available at the present writing. It is known however, that the device is worked by electricity and that in case of defect it can readily be detached and the engines worked in the ordinary way. This change does not require more than three or four seconds, according to reports.



Modern coal tipple, showing weighing house and inclined plane

In the earlier period of coal mining in this country in some cases only 30 per cent of the coal was recovered Under the best current practice we are recovering 85 to 90 per cent



Electric mine locomotive pulling trainload of coal

It is largely by the use of improved mining machinery that the average American miner produces something like three times as much coal annually as the European worker

Preparedness for Peace in the Mineral Industries

What is Being Done to Eliminate Waste

By Stuart B Stone

WHEN the ruling forces of the Old World first let loose the dogs of war spreading frightfulness and carnage over half the globe business America stood aghast half stunned, afraid to move, to buy to build, to employ Stock exchanges closed, wheels and spindles slacked motion pay envelopes dwindled Then gradually the truth began to dawn upon our tradesmen and producers that the end of the world had not yet come First came the spurt of war orders, later to develop into a continuing flood Then it was realized that, while great trading and manufacturing nations had put down the yardstick and the monkey wrench for the saber and the hand grenade, the black and brown and yellow peoples whom these warring nations had been accustomed to supply still required food and raiment, things to work with and things to play with, and were ready to buy these things—from nations not at war The American consular agent, the American commercial salesman—and particularly as regards the mineral industries the American chemist and engineer and metallurgist—got busy The result in 1915 was an export trade of $3,555,000,000 exceeding the 1914 figures by 70 per cent, and breaking all previous records.

Secretary of the Interior Lane recently said

With the exception of one or two minor minerals, the United States produces every mineral that is needed in industry and this can be said of no other country We produce 66 per cent of the world's output of petroleum 60 per cent of its copper 40 per cent of its coal and iron and 32 per cent of its lead and zinc We can build a battleship a railroad or a factory entirely from the products of American mines and forests To replenish the soil we have phosphorus in abundance potash is known to exist in the deposits of Searles Lake California and in alunite deposits of which are found in several states and nitrogen can be extracted from the air by cheap hydro electric power So that we can feed the earth and keep it sustained And to crown all this we have water power that can be made to generate perhaps as much as 60 000 000 horse-power

The questions now being asked are "How can this nature favored nation be rendered commercially near independent—self supporting with tidy surpluses for export? How is this new and lucrative world trade to be held?" "How shall Made in U S A continue to be seen from Mandalay to Callao?" "How shall we prepare for peace?"

This can be done, so far as the mineral industries are concerned only by economical efficient and honest methods of production utilization and distribution

The present cry for mineral conservation only accentuates and accelerates the movement which really received its first notable impetus from the Conference of Governors called by President Theodore Roosevelt in 1908 Up to that time, it has been said, the nation was lighting its cigars with ten dollar bills, skimming the cream of its God given resources and throwing away the slightly less rich residue spending its stupendous mineral wealth with the abandon of a drunken sailor scattering coin the first night ashore A little coterie of Roosevelt's lieutenants—men like Joseph A Holmes, Gifford Pinchot, James A Garfield and Frederick H Newell—kept the sentiment moving and the idea has made progress steadily since that time Two bureaus of the Department of the Interior—the Bureau of Mines and the United States Geological Survey—are doing notable things for the mineral industries

Burning of 55,000 barrel oil tank, struck by lightning at Tulsa, Okla.

Fires from lightning or other causes have resulted in enormous loss of stored oil or oil from flowing wells

In discussing mineral waste, Dr Charles L. Parsons, chief chemist of the Bureau of Mines, has summarized

Wastes in mineral production and treatment are of many kinds In the process of mining some of the material is inevitably left in the ground, being of too low grade to work with profit, or being necessary for roof supports in the form of pillars In ore dressing and ore concentration the losses are often startling, and in spite of advances in the last few years, this field offers broad opportunity for the investigator Many ores formerly of too low grade to pay for extraction are now sources of wealth and care should be taken to leave low grade deposits in position for future development whenever conditions warrant The dust from stacks and chimneys of all kinds is often not only a great waste of valuable material, but is one of the great evils of modern civilization Losses are caused by the use of material entirely unfitted for the use to which it is put Failure to use resources, the value of which is unknown, gives rise to economic inefficiency New forms of machinery will reduce costs, and entirely feasible precautions will lessen the danger to life and limb

In the past there has been great waste in the mining, transportation and use of coal in the United States Much of the mining was carelessly done, and it is estimated that fully 2,000,000,000 tons of anthracite and 3,000,000,000 tons of bituminous coal have been left in the ground in such a manner that the possibility of its future recovery is problematical

We are the largest consumers of coal in the world using 40 per cent of the world's annual production Probably not over 11 per cent of the energy in coal is effectively utilized the remainder being lost through the inefficiency of the steam boiler, the steam engine and the electric dynamo It is estimated that the boiler scale in locomotives alone in this country means a loss of over 15,000,000 tons of coal annually

One of the efficient methods of conserving our coal supplies is through the utilization of water power Furthermore, the development of the gas engine, by means of which energy of fuel can be utilized without the intermediary loss involved in generating steam, is rapid The scientific control of the combustion of coal under boilers is greatly increasing the amount of energy actually utilized, but the losses of carbon that is still pouring from our chimneys defacing buildings and landscapes, are without justification.

Nearly three fourths of our coke is made by the wasteful beehive process Slightly over one fourth is manufactured in ovens of the by-product type, which permits recovery of gas, tar, ammonia, benzol, and other products. The value of recoverable products wasted in beehive ovens in 1913 was estimated at $45,000,000 Another source of waste is the coke breeze In the coke regions where the old method is used, the breeze, which would make excellent fuel for hot air furnaces in residences, lies in immense piles, unless indeed it is burned as fast as made

The total value of the oil and gas produced in the United States for the calendar year 1914 was more than $300,000,000. The total waste in all branches of the industry probably amounted to $50,000,000. Natural gas is an ideal fuel which has been grossly wasted In

one state from 250,000,000 to 500,000,000 cubic feet of gas has been wasted daily, 80 per cent of which might have been easily preventable The Bureau of Mines estimates that through its efforts $15,000,000 worth of natural gas has been saved in the single state of Oklahoma. More efficient utilization and the prevention of much waste will prolong the life of the oil fields for many years. Vast deposits of oil shale in Utah and Colorado, which can furnish 10 to 60 gallons per ton of rock, constitute an enormous undeveloped reserve of petroleum, and investigations by the Bureau of Mines and the Geological Survey are under way looking to the ultimate utilization of these reserves Formerly kerosene was the chief product sought in the distillation of petroleum, and immense quantities of the lighter and heavier fractions were thrown away Now, however, almost the total output of petroleum is utilized as gas, gasoline, naphtha, benzene kerosene, lubricating oil, asphaltic road material, and carbon for electrical purposes By means of the processes recently discovered by Dr W F Rittman, benzol, toluol and other compounds used in the manufacture of dyes and high explosives can be extracted from crude petroleum Dr Rittman has also devised a process which will enable refiners to increase the output of gasoline from crude petroleum 200 per cent or even more

The metallurgy of iron has reached a perfection beyond that of any other metal The poorer ores are being reserved in a condition available for future use, the methods of the blast furnace, the steel mill, and the foundry have been rapidly attaining high efficiency, most of the waste gases and the flue dusts are being utilized, and the slag is converted into Portland cement at the rate of about 8,000,000 barrels a year Immense as is the available supply of iron ores of present-day commercial grade in the United States, it is not sufficient to prolong production for many decades at the rate of increase in consumption of ore that has obtained thus far Means should be devised for the utilization of the titaniferous ores, of which there are immense deposits not now available by reason of the metallurgical problems involved Many millions of tons of low grade siliceous ores lie unworked in the Birmingham district, which the Bureau of Mines has shown can, by fine crushing and washing, be concentrated profitably There is an opportunity for invention of processes by which ores may be smelted electrically by the use of cheap water power or reduced by the use of fuel oil in regions where good coal is scarce There are also excellent arguments in favor of encouraging imports of iron ore from Cuba and South America, as a means of increasing trade between the United States and those countries and of conserving the ore supplies of this country

With the advent of the steam shovel, improved mining methods, and recent advances in concentrating, immense low grade copper ores are now worked at a profit. Three mines alone now produce about 300 000 000 pounds of copper annually, worth at 15 cents per pound, $45,000,000 Under the mining and metallurgical methods of 20 years ago, this wealth of copper would have remained in the ground The extraction of copper by hydrogravity concentration has averaged about 70 per cent This means that in the United States about 340,000 000 pounds of copper went out with the tailings in 1914, which, if not recovered means a loss of about $51 000 000 a year Almost inestimable losses of sulphur, arsenic, bismuth, etc are now taking place in the flue dusts and flue gases, but there can be but little doubt that these will be controlled in time

Smoke!

Competent authorities have estimated the annual loss in the United States from smoke, in the way of defacement of buildings, damage to health necessity for more frequent painting of buildings etc etc at $500 000 000 Besides smoke means heat-energy lost Proper combustion methods will practically eliminate this loss and nuisance

Gas-producer engine

These engines allow the utilization of low grade coals lignite and peat eliminate smoke, and avoid great loss in heat-energy of the coal consumed

In proportion to output, the losses of zinc are probably greater than those of any other metal Generally speaking it is probable that less than 50 per cent of the zinc reaches the form of spelter Zinc mining is frequently done on a royalty basis, an arrangement that means great waste because the lessee naturally takes out the ore paying the greatest profit and leaves the poorest ore behind without reference to its ultimate loss The losses continue in the utilization of zinc, especially in the manufacture of brass, in which the annual waste amounts to more than $4 500,000 half of which is preventable It has been estimated that 15 000 pounds of zinc escape daily up the stacks of the brass casting shops in Waterbury, Connecticut, alone

In treating gold ores by amalgamation followed by cyanidation about 90 per cent--and in some instances 96 per cent—of the gold content is now recovered Since 1896 by the use of dredges largely an American innovation about $100 000 000 in gold has been recovered by reworking gravels or working gravels that were too low in gold to be profitably mined by any other method The new government railroad into the interior of Alaska should so cheapen costs that many placers from which the cream of the gold has been taken can be reworked and many placers that could not be profitably worked before will now contribute to the output

Vast quantities of low grade complex ores, carrying silver with lead, copper, or zinc are now unworked in the metal mining states of the west because of the lack of processes by which the metals can be recovered at a profit Investigations are in progress under the direction of the United States Geological Survey and the Bureau of Mines to determine the extent of these ores and the possibility of developing processes for treating them profitably Experiments are being conducted by the Bureau of Mines for perfecting details and cheapening the cost of cyanide treatment, which in the Tonopah and other districts has permitted the treatment of low grade ores which otherwise could not profitably have been shipped to smelters

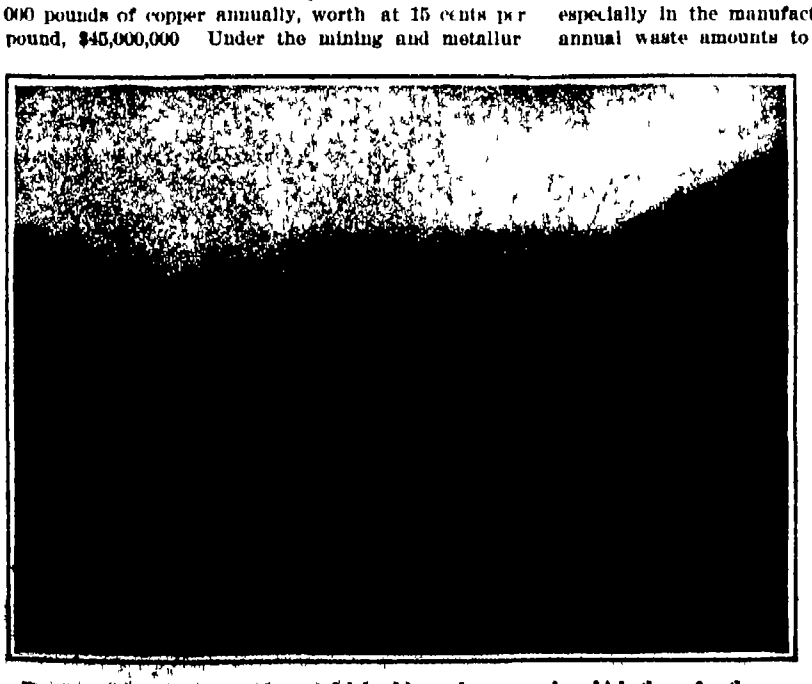
Every effort should be made to search systematically for platinum in the placer and ore deposits of the western states. New devices on gold dredges are saving much more of the platinum than heretofore, and further improvements seem likely British and American capitalists are beginning to develop the platinum deposits of Colombia, in South America, the refining of which in this country would be a boon to the United States

The United States consumes more tin than any other country in the world, and at the same time produces practically none A domestic source of supply is badly needed Alaska produced 100 tons per year for the past three years, and this field is worthy of further development The opening of the Panama Canal should make possible the development of an extensive smelting business in this country, using the Bolivian ores, which have heretofore been sent to England because of lack of fuel in Bolivia for smelting

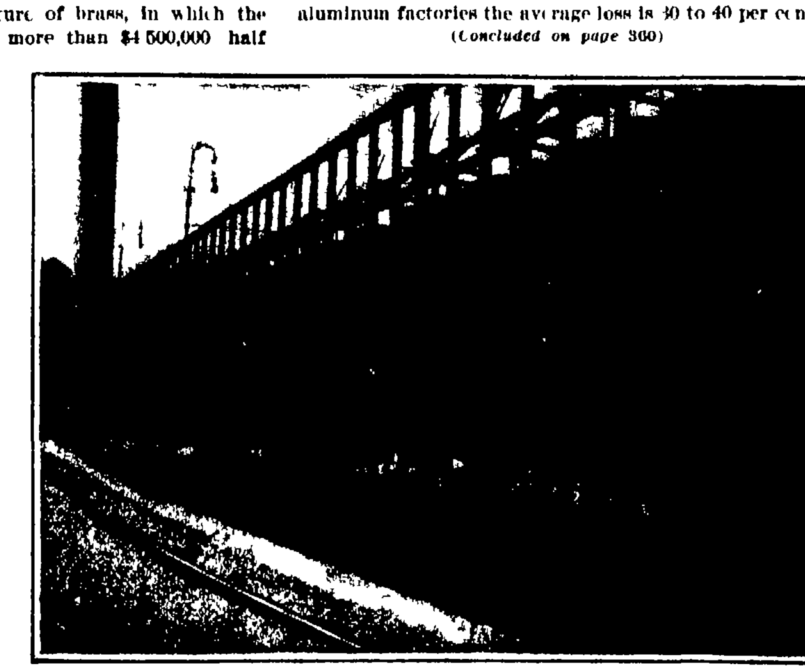
Improved metallurgical processes and the use of oil flotation in milling should enable the states of Missouri and Idaho to develop extensive low grade deposits of lead ores and make the country absolutely independent of foreign countries for this metal

Aluminum is still obtained from but one ore bauxite, which is needed for other purposes Any method for producing aluminum cheaply from common clay which contains 10 to 30 per cent alumina would be of inestimable advantage In some melting processes in aluminum factories the average loss is 30 to 40 per cent

(Concluded on page 360)



Battery of the obsolete and wasteful beehive coke-ovens, in which three fourths of our coke is still made, entailing an annual waste of more than $45,000,000



Battery of by-product coke-ovens, which save the exceedingly valuable gas, tar, ammonia, nitrogen, benzol and other products. This type of oven is rapidly replacing the wasteful beehive oven

War Game—III

The Advance to the Battle Field

By Guido von Horvath

IN its essential parts the small combat and the great est battle are identical In a small combat, a detached engagement the issue is soon decided and the result is decisive In a great battle, made up, as it is of a series of smaller engagements the issue may be in doubt for a considerable time and the results difficult to determine In all cases however the commander, in making his strategical or tactical plans must consider the same elements the fighting forces under his command the terrain—the field of action and the time element—the limits within which he must act to get the results planned

To illustrate this we must refer to Colonel K's detachment This detachment consists of four battalions of infantry one battery of field artillery one platoon of engineers and the trains These are the active fighting forces The terrain shown on our map and in the perspective is the field of action Time is the important factor which we must consider in planning to bring our fighting forces on the field of action into the positions which the situation demands

It is evident that no one of these three elements can be slighted While the issue is decided by the fighting forces their action is limited by the terrain and the time allowed for the accomplishment of their mission

Before going into the details of the present Game we must know something of the principles of the development of a fight or combat. In our problem we have reached the stage where we have information of the strength of the enemy opposing us We also know that this invading force is advancing with the evident purpose of bringing on an encounter We are therefore about to come in contact with the enemy Our advance cavalry is already in touch with him

In War Game II we saw the work of the Advance and Flank Guards Now that we are advancing with the information of the strength and the aggressive purpose of the enemy the service of security on the march will naturally gain in importance It is necessary to exercise greater vigilance, if such a thing is possible, to guard against surprise movements by the enemy This may be done by strengthening the advance guard and by making closer the screen of the flank guard

Colonel K's detachment will move forward to accomplish its mission under the cover and the security furnished by its advance guard

It must always be assumed that the enemy invading force acts in such a manner that his advance is as well protected as is our own, and that his independent cavalry and patrols are covering his front Therefore skirmishes may be expected between the opposing security forces

Ordinarily, our independent cavalry will have completed its mission by the time this stage is reached It would then become available to assist in delaying or defeating the hostile advance troops, and also in further reconnoitering and harassing the enemy's main forces

Successes in the early stages of the advance are very important They gain for the advance guard commander liberty of action and give him the advantage of the initiative, and thus an opportunity to impose his will upon the enemy

Once this stage has been reached by the opposing forces, the commander of our detachment must make up his mind as to his further actions He must then put his decision into the form of precise orders In forming his plans there are four possible courses of action open to him

1 To maneuver so as to gain time or advantage of position

2 To avoid an engagement,

3 To attack the enemy,

4 To take a defensive position and await the enemy's attack

Before deciding on our plans we must know something of the ways and means of actual fighting

We have previously stated that the company fights in line but we did not go into the details Now we must take up these details in order to get a complete understanding of the task in hand

Deployment for Combat

The different arms of the service infantry cavalry and artillery all have their own ways of fighting To a degree these ways are similar, but nevertheless each arm has a precise rule, based on its own weapons. We shall therefore consider them separately

The Infantry The infantry fights both with rifle fire and with the bayonet. Therefore, its deployment or, to speak in non military terms, its fighting formations are such as to give the best opportunity for this fire, and for the bayonet attack at close range We must consider here that it is possible that infantry fire may be employed at about 2,800 yards This is distant fire, and is advisable only against large targets, 2,000 to 1,200 yards is termed long range, 1,200 to 600 yards, effective range Close range means that we are firing within 600 yards of the enemy

In order to show the method of deployment we shall work out the action of the company which has just advanced to within distant range of the enemy, about 2,800 yards.

The company takes a line formation If a sufficiently large target should offer itself, volleys might be fired by the platoons, one after another from covered positions Should this fire not be taken up, the advance against the enemy from this point on would be made in formations different from those already explained We are describing here nothing but the attack of a single company of infantry acting alone

As soon as the company goes into action, from 2,800 yards on, it must deploy—that is, extend its front This means that it must take a formation which admits the best use of fire involves the least exposure to enemy bullets and provides a sufficient momentum for the advance The platoons, as we have said before, are divided into squads At the company commander's order, one or two platoons, as the case may be, will take an open formation and advance (See diagram)

Thus one half of the company is changed into a single line, with considerable distance between the men and a greater distance between the squads, about 150 or 200 yards ahead of the remaining two platoons. The result of this movement is that the first and fourth platoons have formed a skirmishing line, while the other platoons form a company reserve Quite naturally, the thin skirmish line is the firing line

From this point on the combat will consist of alternate firing and advances, with the best possible utilization of the natural protection offered by the ground Once within effective range, the platoons will move forward alternately, so that the fire of one platoon will cover the advance of the other In the later stages of the attack it will be necessary to fill in and strengthen the firing line with part of the reserves But the company, when acting alone, must always retain at least one platoon in reserve in order to carry through the bayonet attack.

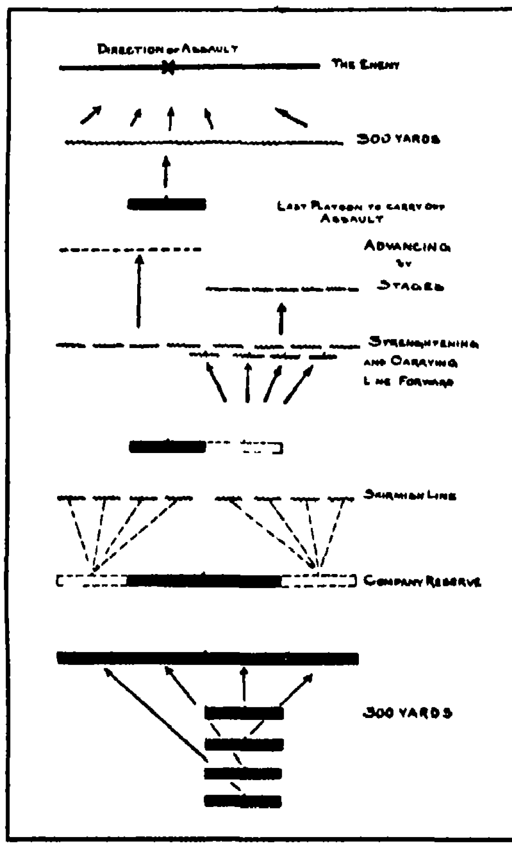
What we have here shown for a single company will also serve as an example of the actions of larger units. The main difference will be in the size and composition of the reserve Every command will retain a portion of its force to act as a reserve to be used in pushing the advance and to give the weight at the time of the final thrust.

In considering the special task of our detachment there will be used company, battalion and detachment reserves. The further details we will work out as the various problems are solved

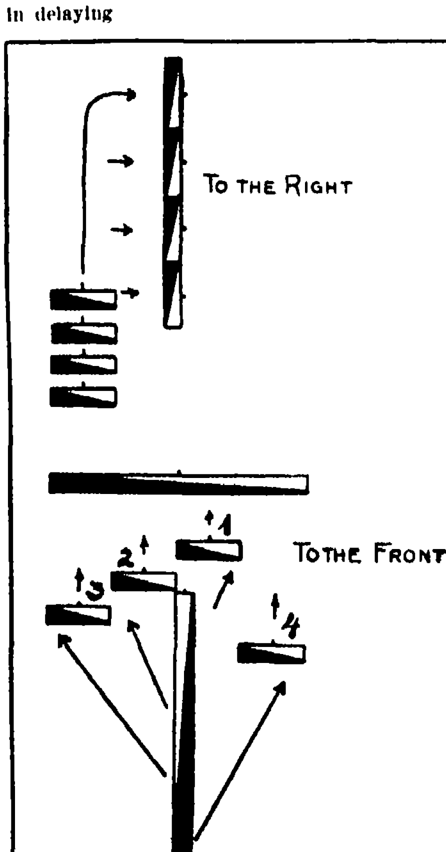
The Cavalry The duties of the cavalry are in many ways different from those of the infantry, yet, in case of need, the cavalry can successfully undertake infantry action. In such a case it dismounts and acts exactly like infantry

The service of reconnaissance is not and should not be a fighting task, although it will at times be very hard to avoid scrimmages. When cavalry, in larger units, carries out a reconnaissance in force the skirmishes with the enemy cavalry will be numerous. Cavalry has a simple method of attack against cavalry, the attack is made in line and with increasing speed, the enemy is rushed. The force of impact, as much as the work of sabres or pistols, will have great influence in winning the victory Against infantry, a skirmish charge has to be made, and it can succeed only when delivered as a surprise. The chief uses of cavalry, aside from reconnaissance, are the harassing of an enemy's flanks and rear, covering and screening

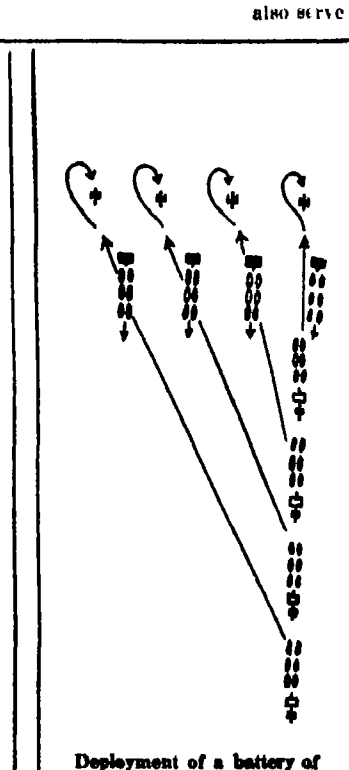
THIS series of war games began with the issue of March 11th which deals with a Strategic Reconnaissance of Four Cavalry Patrols The second war game was published in the issue of March 25th and dealt with the Service of Security on the March and at the Halt In each game problems were presented the answers being published in the succeeding installment Answers to the problems presented in the present installment will be found at the end of War Game IV, which will be published in next week's issue of the SCIENTIFIC AMERICAN *Copies of the enlarged colored map covering the terrain of the war game may be procured at 10 cents each*
EDITOR.



The theory of deployment, fire combat, advance and the final assault by a company



Theory of deployment of a squadron



Deployment of a battery of four guns

the movements of the main body, and securing in advance favorable positions for the slower moving infantry (See diagram)

The Artillery This is the most important branch of the army, but, deadly and powerful as it is, it always demands the protection of Infantry or Cavalry, for once approached by the enemy it cannot defend itself

The Artillery has but one way of promoting the final success of an engagement its fire effect The effective range for field Artillery is inside of 4,000 yards although it is able to throw its missiles 6,500 yards or more. Field Artillery is almost as mobile as Cavalry, therefore it can be placed at the desired point on short notice

It is very important that the reader understand that the Artillery is *not in line with the Infantry*, except in extremely unusual cases, but always behind the firing line often at a considerable distance The shells and shrapnel are fired over the heads of the advancing Infantry

To aim a gun it is not necessary for the artillerymen to see their target they are always directed by officers from observation points In order to hit the mark, the direction of the target and the distance in air line must be known Once these factors are known, the elevation and deflection of the gun is given and, at the command of the observing station, or, if the target is in sight, as in direct fire at the command of the commanding officer the gun is fired The accuracy of artillery fire is remarkable and its effect may be very great.

As far as our present problem is concerned it is enough to know that there are two kinds of shells in use the high explosive and the shrapnel The first is constructed with a mechanism which bursts the shell at its contact with the ground or any resisting object The shrapnel is provided with a time fuse, which is set before loading and which explodes in the air at the desired distance, throwing several hundred bullets, and sometimes the broken fragments of the shell, against the target.

Under any circumstances, the commander must provide for adequate protection for his artillery This protection can be either Infantry or Cavalry

The placing of artillery in the field will be clear from this illustration

All this understood we are ready to take up matters with Colonel K's detachment.

Situation

At 6 A.M the detachment is in marching order A train with supplies, has arrived during the night from the south Colonel K, at the northern edge of the village, with his map in hand, after a brief study and consideration, gives the following verbal order

His Staff and Battalion commanders are present.

The enemy, three battalions of infantry and one battery of artillery strong, is marching on Pottstown. Its advance guard has just passed the big pine tree on the Nohaminy River A few of his patrols are reported on the left shore.

Our division is approaching from the south.

Our detachment will advance to secure the bridges northeast of Pottstown, and to occupy Lookout Hill

Our independent cavalry will harass and delay the advance of the enemy

On account of the nearness of the enemy to the bridges, the First Battalion will immediately board the waiting supply train, cross to the right shore and hold same.

The Second Battalion and platoon of Engineers, as Advance Guard, will cross Conestoga Creek at railway bridge and will follow the railroad until the road leading to the Pottstown Island bridges is reached Thence to Lookout Hill, where communication and coöperation with the First Battalion must be established

I will be with the Reserve of the Advance Guard

* * * * * *

To Captain C, independent cavalry, the following order is sent by heliograph.

"Detachment will reach Nohaminy bridges at 9:00 A.M. One battalion by rail at 7:30 A.M I propose to occupy and hold Lookout Hill. Delay enemy's advance until 9:00 A.M.

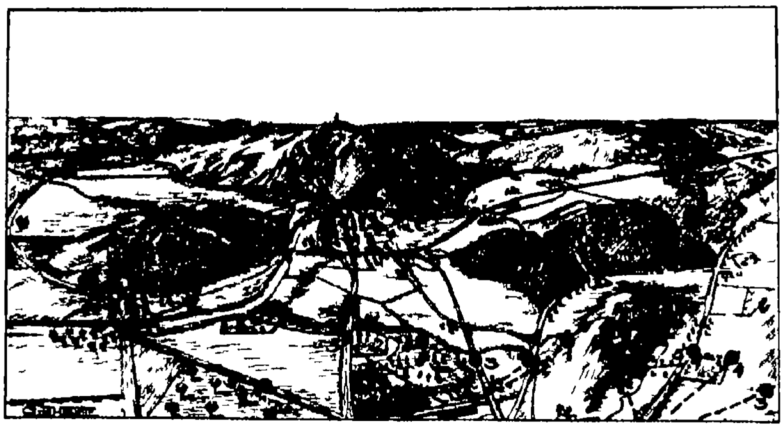
Considerations

Colonel K's orders are based on the information he has received from the Advance Cavalry and from his orders from the Division Headquarters

The development and the working out of this situation is somewhat complicated by the fact that the enemy is slightly nearer to the points which Colonel K wants to reach than is his own detachment

The train therefore is used to overcome the influence of distance

The Colonel is quite justified in using this emergency measure and under the existing circumstances it can be undertaken with rather good chances for success He knows that only small enemy patrols are on the left shore of the Nohaminy River and that the Advance



Bird's-eye view of terrain depicted below

Map illustrating the advance to the battlefield

Cavalry serves, to a certain degree as an Advance Guard Besides this, the time and distance are such that this separation of the battalions will be for a short time only

We must also consider one important thing which will have some bearing on future developments This is the fact that our detachment marches on roads, whereas the enemy, in order to reach Pottstown from its present position, has to march across country without roads, until the Greenville Road is reached There it crosses Timcum Creek on the railroad bridge This bridge might not permit the passage of artillery, and eventually might force the enemy to a detour and the use of the two other bridges northwest from the railway bridge

Therefore, the main problem lies in the dispatch with which the greater distance is covered To this end the train is used as well as the order to the cavalry to harass and delay the enemy in its march

As a matter of course every commander must consider that the enemy forces will be utilized with similar intents

Developments and Questions

The plan of outpost service shows the situation of the detachment at 6 A M Now here are certain important phases which must be understood before we can go further in our game One of these is What shall become of this outpost line? How will these scattered troops act to fall into column of march with the rest of the forces? It is understood that at 6 A M when things began to happen the elements of the outpost were still at their respective locations

Question 1 Figure out the road or direction by which A Company will fall into line of march B Company? The outpost reserve, which was C and D Company?

It must be considered that the commander of the 3rd Battalion was present when Colonel K gave his orders for the march, therefore this commander's duty will be to immediately issue orders for the assembly and relief of the outpost

* * * * *

Question 2 Formulate an order which will be adequate to bring about the relief of the elements of the outpost

Composition of orders of tactical nature must be made with the following points in view

1 The enemy
2 Our own intentions
3 The disposition of troops of our own unit to carry out our intention
4 The place where commander can be found

* * * * *

At 7:30 A M the train carrying First Battalion reached the southeastern fork of the railroad near Pottstown There the train halted A few minutes later a rather heavy explosion was heard coming directly from the north

Question 3 Account for the explosion

* * * * *

The First Battalion commander decides to disembark his battalion at once, and to cross the river via the island bridges

Question 4 Since his orders demand from him the securing of the bridges east of Pottstown how will he proceed to secure these thoroughfares of great tactical importance?

The main question here is to find the right way of occupying and holding these two bridges The terrain must be very closely considered and also the means by which infantry holds a position Consideration of these two elements and of the strength of the forces in hand and to follow will determine whether to go beyond the bridges and choose a position blocking the approach for the enemy, or by preparing trenches and utilizing the river as a serious obstacle to defend the southern bank around the bridges.

The first way is a positive achievement, the second a passive defence

* * * * *

Question 5 Provided the commander of the First Battalion has decided to push forward immediately, what will be his order, and his first aim?

Consideration must be given here to the orders issued by Colonel K at Norrisville and to the topographical situation

Question 6 The First Battalion has reached Argus Farm on top of Lookout Hill What will be the Battalion's tactical formation?

Consider the nearness of the enemy, the dangerous wooded slope marked "Pine Forest," the road and railroad leading through these woods, also the fact that the railway bridge is to be covered

Question 7 Mark the position of Colonel K's detachment on map at 9 A M

Carefully consider diagrams showing the deployment of a company for combat and the possible application of the same to the topography of the field of action.

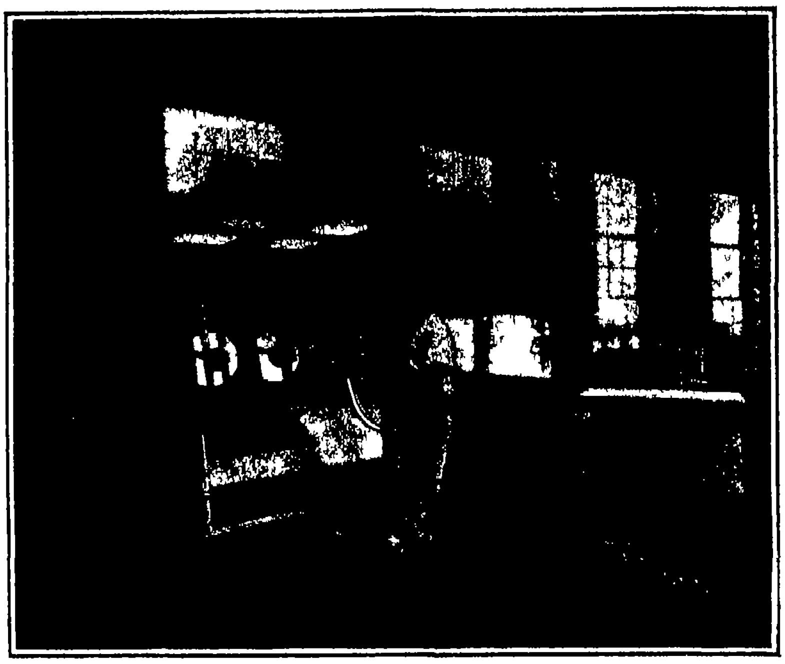
(Concluded on page 364)

Finishing Furniture with the Use of Compressed Air

IF you should make a trip to some modern furniture factory you would be disappointed if you expected to see men putting varnish enamel and other first coaters on their products with a hand brush. Times have changed. Hand brushes are too slow and inefficient in these days of quantity production and compressed air has taken the place of the hand brush worker.

To-day you see a bedstead entirely coated with a varnish gun in less time than it takes to describe the process and all done in so scientific a way that fumes from the material are removed—in fact all dust and loose dirt are removed from the article by compressed air as the varnish is applied. The hose receives its supply of material from a container hung by a safety arrangement above the head of the workman. Gravity causes the material to flow into the nozzle of the apparatus. Here it is properly mixed with compressed air so that a delicate fine spray or a heavy one is at the disposal of the workman.

There are hundreds of factories using the new system for placing finishing material on wood and metal parts. Automobile bodies are treated with the finishing material by this process. In case of large articles, they are placed on a turntable inside a protected area, or what is called the "fumexers." By a specially-designed exhaust apparatus all fumes are removed from the finishing room insuring better health conditions for the men.



Workman applying varnish on furniture by means of a varnish-gun. The hood in which he works is equipped with exhaust fans

A Mechanical Method for Scraping Motor Bearings

TO perform mechanically the tedious work of hand scraping the babbitt or bronze bearings of automobile motors and other machinery is the purpose of an aligning reamer recently perfected by a Massachusetts manufacturer.

Hand-scraping the crank shaft bearings of an automobile motor usually requires from three to five days. Each bearing must be scraped with a hardened steel scraper, and while bringing it to size the mechanic must be careful that the metal is removed in such proportions as to bring the bearings in final alignment, and located so that the gear on the crank shaft which drives the cam shafts will mesh perfectly with the gears on the cam shafts. The mechanic accomplishes this by applying "Prussian blue" or some coloring material to the journal of the crank shaft and taking "prints" of the bearings. This process, often repeated, consumes several days.

By the new mechanical method, however, it is possible to ream the bearings of a motor in one day or less, producing bearings accurate in size, perfect in alignment, and having smooth, burnished bearing surfaces. An aligning shaft longer than the crank case of an automobile motor is set up in the bearings, supported by means of adjustable eccentric bushings having finely threaded tapered sleeves, which screw into the softer metal of the bearing lining. By manipulating these eccentric bushings, the shaft may be first located to insure gear mesh and then aligned from bearing to bearing.

The reamer head, which may be held at any point on the aligning shaft, is set with a micrometer to an exact size determined by calipering the crank shaft journals. The bearings are then reamed out in succession, operating the reamer as an ordinary hand reamer. The blades of the reamer head are formed so that the bearing is not only bored out but the surfaces are burnished. This does away with the necessity for a long "running in" of the motor which is usually required after hand scraping to wear down to a good bearing surface. The illustrations show how readily the reamer may be set up and operated. On some types of cars, a burned-out bearing may be replaced and aligned with the other bearing or bearings without removing the engine from the chassis.

Method of using the mechanical belt lacer

Mechanical Belt Lacer which Replaces Manual Belt Lacing

SPLICING of belts by skilled workmen is in a fair way to become obsolete. There is another and better way. A machine has recently been put on the market that does this work so perfectly and efficiently that the joint made has a tensile strength of 2,000 pounds.

But one man is required to accomplish the hardest job of belt splicing with the new machine. The joining together of the parts is in the form of a hinge joint and pulleys small in diameter have no terrors for it. No jerking slipping or other vibration is experienced with a splice made by the mechanical splicer.

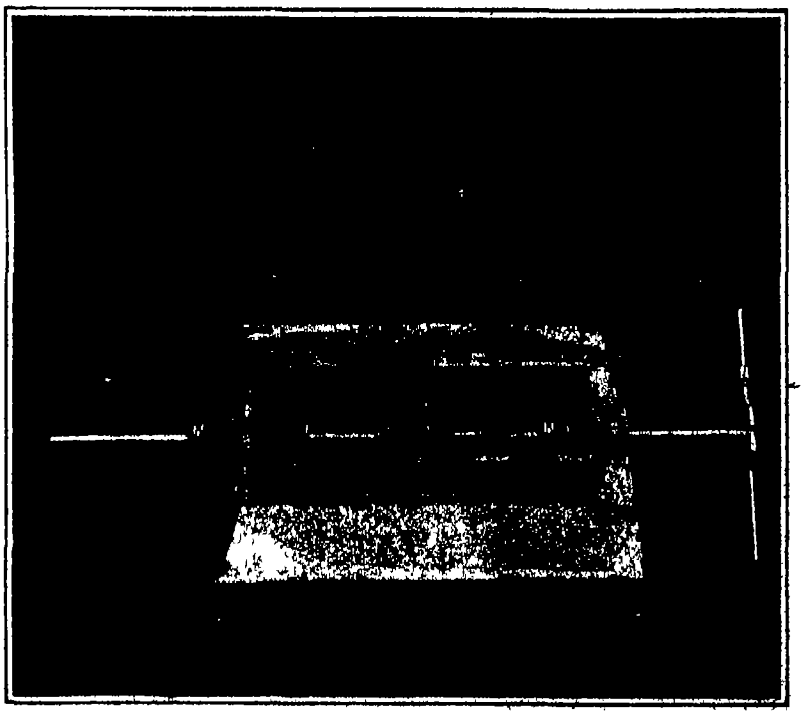
The operation of the machine and the apparatus itself is interesting and represents the thought of some mechanical genius. It is as follows.

Three corrugated rolls are operated by a crank. Between the rolls a spiral needle is inserted and when the crank is turned it is carried through the ends of the belt, making perforations of very small diameter. After this first operation, wire lacing is run through the perforations in the same way the first operation was performed. After these operations the coils are flattened and forced far into the belt. By this method loops are made, and by raw hide pins these are coupled together. With this last operation the lacing is complete.

Besides saving time for the man who owns one of these worthwhile machines, there remains yet another point to its advantage. Numerous small pieces of belting are from time to time cast aside for the reason that a belt pieced together by hand from small parts would be too expensive and, more important still, would not be efficient. The mechanical lacer joins such parts easily and thoroughly, resulting in an easy run and as smoothly as some others composed of longer sections.

The machine has been mounted on wheels, permitting it to be taken to the scene of action, instead of bringing the belt to the machine. In some cases it can be equipped for power operation.

Reaming bearing No. 1. Note that aligning shaft has been accurately located to insure perfect gear mesh between crank shaft and cam shaft gears



Reamer head in position to ream bearing No. 2. Note that adjustable bushings which support shaft are screwed into soft metal of bearings

Fencing Tournaments for Blind Men

Latest Parisian Fad Which Affords Much Pleasure to Participants and Spectators Alike Because of Its Novelty

By Arthur Kennedy

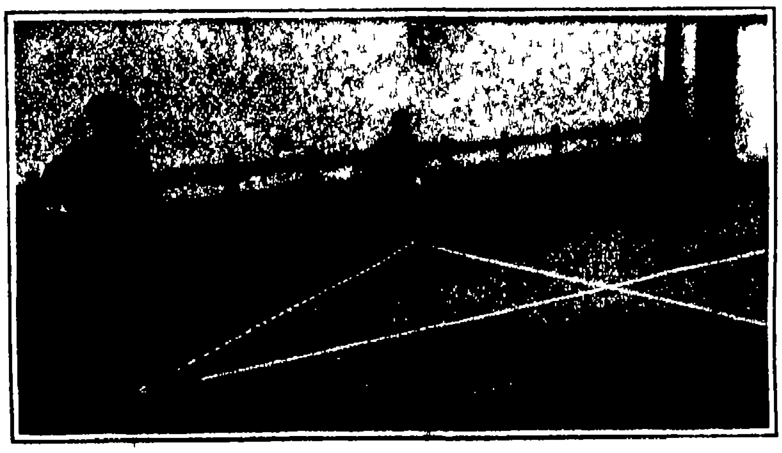
NEVER before has the problem of finding employment for blind men been so vast as at present when the European war has added tens of thousands to the already large number of such unfortunates For the greater part the governments of Europe have devoted their energies to finding suitable work for blind men and training them in their new found tasks Recently, however, the French have endeavored to create various diversions as well for those whom the war has deprived of their sight, among which is fencing

To the lay mind it is indeed difficult to conceive how an active sport such as fencing can be indulged in by sightless persons Yet fencing tournaments in which blind men are the only participants are now common in Paris, and are a source of much enjoyment to both the participants and spectators At the same time the sport is of great value as a physical and mental exercise

George DuBois, who is at present the blind master of the foils, is the originator of fencing for the sightless As might naturally be expected, he has had to train his pupils with great patience, for if the teaching of fencing is a matter of much practice and perseverance for those possessing all their faculties surely it is ten fold more difficult to master by those who have been denied the use of their eyes. In the headpiece, M DuBois is seen instructing a student in one phase of fencing

The fencing ground is marked off by two lines at right angles, in the form of steel ribbons. In one of the accompanying views is shown the position of two opponents just before the fencing match the instructor stands at one end of the steel tape which runs down the center of the courtyard in which the tournaments are held, while the pupil is seated on a wall bench directly in front of the other line The line running down the center of the court is known as "the line of the professor" while that intersecting it at right angles is known as "the line of the student.' The dotted line represents the path of the sound waves when the professor or instructor calls on the student who, being familiar with the dimensions of the triangle can approximately gage the distance between the point where his line intersects the "line of the professor' and the instructor Upon receiving the command the student stands and walks forward on the line in front of him until he reaches the intersection of the two steel tapes whereupon he does a half turn so as to bring him face to face with the instructor standing on the same line The student salutes his opponent and walks forward on the line of the professor' until his foil held straight before him touches the breast of his opponent thus indicating that the proper distance separates them They then cross foils and engage in the fencing contest Obviously the blind men engaged in the sport of fencing must rely on their sense of touch almost exclusively and in this respect the steel tapes resting on the ground are of great assistance to them

So popular have been the fencing tournaments for blind men in Paris that several schools are now in existence in that city opened only to students who are totally blind

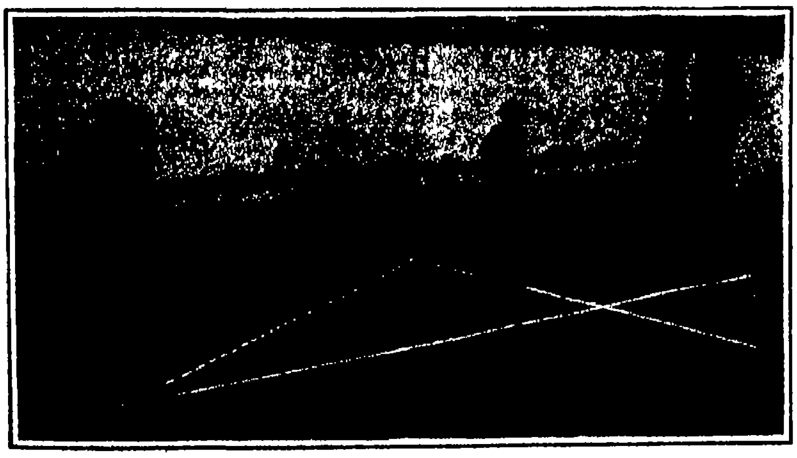


First position in blind fencing Student seated at the end of his line, awaiting the command of the instructor

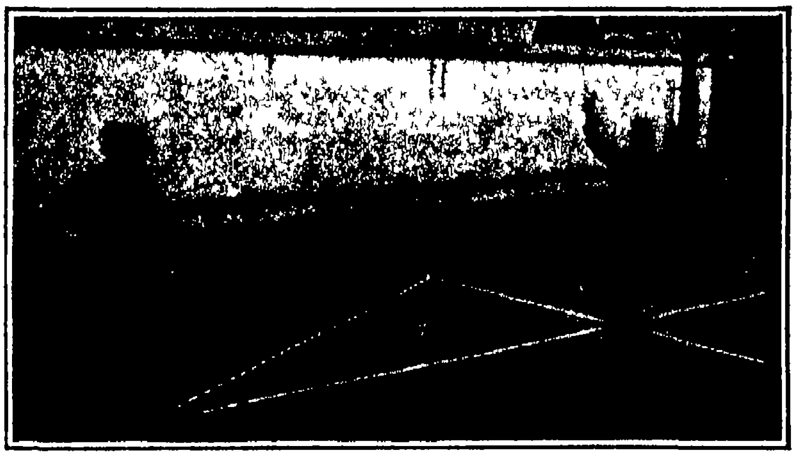
New Process for Removing Solder and Tin from Scrap

AMONG the recent patents filed in England is the process for removing the solder, tin and chemicals from scrap and galvanized articles and for utilizing the base metals. The inventor is a South Wales tin plate worker who has already secured contracts from several municipalities for treating down refuse such as tin cans, containers and similar metallic waste products

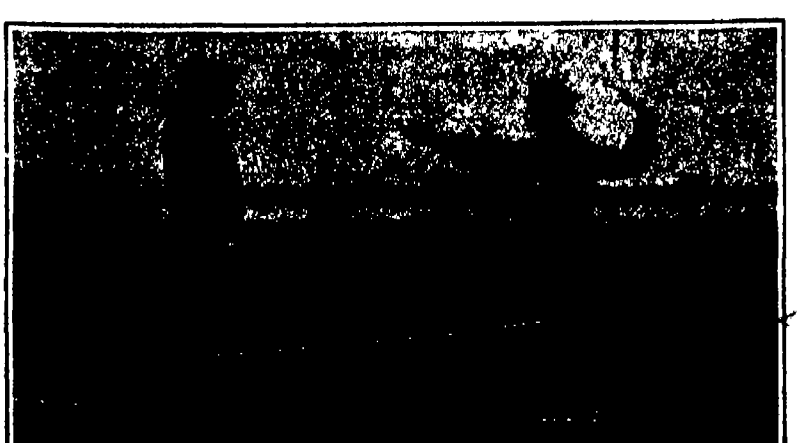
Formerly large quantities of old tins were taken by Continental dealers practically at the cost of carriage to be utilized in manufacturing cheap articles such as toy soldiers novelties mechanical toys and a large assortment of nondescript articles usually found in shops handling inexpensive goods The usual processes in manufacturing such goods only necessitate a simple cutting or stamping and a light coating of enamel or paint For the most part, Germany has been the greatest consumer of scrap tin in the past for the manufacture of toys.



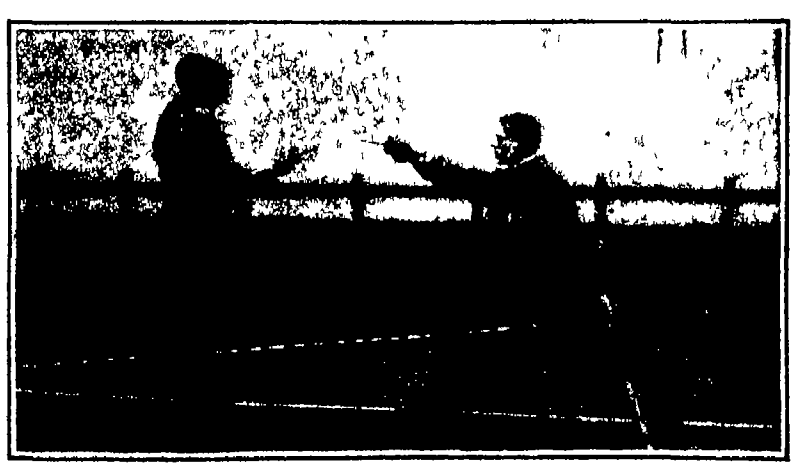
Second position: Student after receiving the command, walking straight ahead on his line



Third Position After having reached the intersection of the two lines, the student turns and salutes



Fourth position: The student holding his foil straight before him, touches the instructor's breast so as to gage their distance apart



Fifth position: After crossing foils, the instructor and student engage in the actual fencing exercises with a dexterity that is astonishing

Strategic Moves of the War, March 24th, 1916

By Our Military Expert

WHILE general attention has been centered for the last few weeks on the more spectacular activities in the Verdun sector of the theater of war, events of moment have occurred in the East where the Russian armies in the Caucasus and in Persia have made consistent progress.

The head of the Russian hammer is swinging through Persia, the general movement being pivoted upon the vicinity of Trebizond far to the northwest upon the shore of the Black Sea.

News of definite accomplishment comes late, especially from such a distant line. Therefore, while the fall of Kermanshah and Ispahan are reported, comparison of the speed of the Russian advance from previous points with the time elapsed leads to the belief that the columns of advance must now be well beyond their present reported positions driving steadily toward the Persian gulf and the beleaguered British forces in Mesopotamia. Analysis would indicate that the column from Kermanshah has probably reached the border between Persia and Turkey through Khind where one of the best roads leading toward Bagdad is to be found thence overland to the border. This should put the Russian forces within about 100 miles of Bagdad and little farther from Kut El Amara almost directly southward of the present position.

Hamadan was a most important capture, although no considerable feat of arms was required in its taking for the forces opposing the Russian advance were rather weak and poorly organized. This city is a center from which many usable roads radiate, in all probability therefore, it has become an advanced base not only for the supply of the main column which seems to have followed the Bagdad road through Kermanshah but for the supply of subsidiary columns as well to either side. The whole Persian movement in its present phase commenced at Teheran and Kaswin, extended south west directly upon Bagdad and southward toward the Persian gulf through Kashan and Ispahan which latter is reported as fallen into Russian hands on March 10th. From Kum, between Teheran and Kashan a connecting column of advance has proceeded in the direction of Kut El Amara, with a probable first objective at Khurramabad which must be amply covered by Russian lateral thrusts from Kermanshah.

It is all a wild country and the continuous lines of battle which mark the main eastern and western battle fronts of Europe do not exist. Roads are too few, and sections of the country too forbidding to render supply of such a line possible. The movement, then consists of a number of columns following the roads and, in some cases breaking an independent way. Each of these columns, of whose strength and number little is now known in this country seems to be acting as a separate force although each column has its definite place in the grand strategic and tactical scheme of the Grand Duke.

To connect up the remainder of the Russian line the recently captured harbor of Riza 35 miles from Trebizond, is to be utilized as the base for Russian operations upon the big Turkish city. That there will be serious opposition to this advance is doubtful. Trebizond is not supposed to be a strongly fortified point and the news that the American consul there has taken over the German consulate rather suggests that no serious resistance is contemplated.

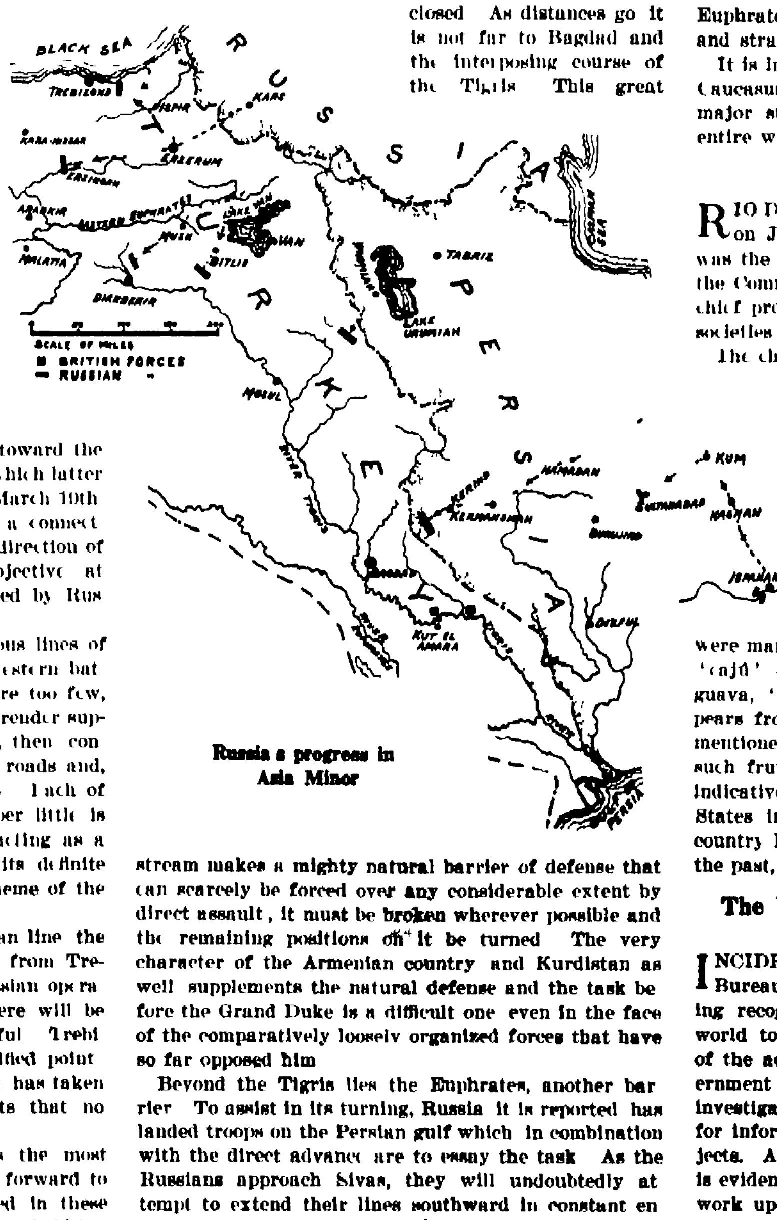
The Erzerum force which comprehends the most powerful of the Russian forces has pushed forward to Erzingan, a movement which was indicated in these columns about two months ago as a strong probability, and the city was evacuated without desperate resistance. Erzingan is not really a fortress city although it is valuable to Russia on account of the concentration of roads upon it. The Turkish forces are reported as retiring upon Sivas about 150 miles from Erzingan closely followed by the Russians.

But it should tell another story, the report when Sivas is reached. This city is directly on the most feasible line for the bottling up operation which is the objective of the entire Caucasus campaign. This line extends from the Black Sea coast west of Trebizond through Sivas to the Gulf of Alexandretta on the Mediterranean and as it is the narrowest point across the Turkey in Asia peninsula, it will doubtless be defended with desperation. Successful occupation of this peninsula by the Entente forces would sever Turkey's principal territory from the Teutonic alliance, deprive the Kaiser's forces of such supplies as have been drawn from the section, shear Turkey's main possessions from her and definitely lay the spectre of Egypt under the heel of a Teutonic invader. At the present moment, this passageway through Asia Minor represents the only mode of egress and communication with the outside world remaining to Teutonia.

Tremendous efforts have been bent toward completing the Bagdad railway, Germany is not going to passively abandon all this without a struggle, for it is generally admitted that her place in the sun lies here. It is therefore a certainty that when Trebizond falls—as every condition indicates it will ere long—the first step in taking possession of at least a part of this plugging line will have been accomplished, then the Erzerum-Erzingan force of Russian strength must set the next block by laying siege to Sivas and controlling the country intervening between it and the Black Sea.

To complete the line one must look at the present position of the Russian forces south of Erzerum. The line sways southeast west of Mush west of Bitlis in a broken way controlling the entire Lake Van region. This line continues across the Persian border until it connects with the forces operating in Persia as outlined in the first part of this article.

It is this line which must close the gap if it is to be closed. As distances go it is not far to Bagdad and the interposing course of the Tigris. This great stream makes a mighty natural barrier of defense that can scarcely be forced over any considerable extent by direct assault, it must be broken wherever possible and the remaining positions on it be turned. The very character of the Armenian country and Kurdistan as well supplements the natural defense and the task before the Grand Duke is a difficult one even in the face of the comparatively loosely organized forces that have so far opposed him.



Russia's progress in Asia Minor

Beyond the Tigris lies the Euphrates, another barrier. To assist in its turning, Russia it is reported has landed troops on the Persian gulf which in combination with the direct advance are to essay the task. As the Russians approach Sivas, they will undoubtedly attempt to extend their lines southward in constant endeavor to gain ground and draw the stopper closer to the southern end of the gap. It is therefore clearly to be seen that Russia is attempting literally to sweep across Turkey in Asia, and brush the debris into the sac between the Black Sea and the Mediterranean.

It is the belief of the writer that one of the most sanguinary battles of the war is coming in this vicinity within the next few months or weeks. Relieved of the necessity for guarding the Dardanelles in heavy force, it seems entirely possible that Turkey can concentrate a million men across the neck of the peninsula, regardless of whatever force Germany and Austria can manage to send to assist them. Every advantage of communication will rest with the Teutonic defenders, except in the vicinity of the Black Sea, which is under Russian control and the more the line retires toward Constantinople, the more advantage for the defense.

Bulgaria does not dare dispatch troops to aid Turkey: her doors are none too securely locked, for the force at Saloniki is not remaining there, increasing in strength all the time, for a mere junket, Roumania is a constant menace, almost 200,000 Serbs and Montenegrins are being reorganized and equipped near the shores of Greece.

But a million men with the advantage of interior lines and comparatively short communications, constitute a very strong and dangerous defending force.

It is the opinion of practically every observer that the only hope of full Russian success in this theater of war lies in the exertion of general Entente pressure on all lines. The newly initiated Russian activity in Bukowina and to the northward indicates the beginning of the long heralded Russian offensive, with the secondary motive of swaying irresolute Roumania to active support of the Entente, England and France, if activity is to be effective and ample, must attack also, and Italy cannot be idle.

It may therefore be said that the situation in Turkey is in its second stage, the first, of preparation and initiation has passed, with splendid strategy and tactics the Grand Duke has done his difficult part carrying the situation up to the present. The third will obtain when Sivas is reached and when—if—the forces to the southward of Erzerum gain the Tigris and the Euphrates when Germany's magnificent organization and strategy must be reckoned with on the battle-line.

It is interesting to observe that the operations in the Caucasus and Persia constitute practically the only major strategic and tactical moves combined of the entire war since the battle of the Marne.

First Fruit Exposition in Brazil

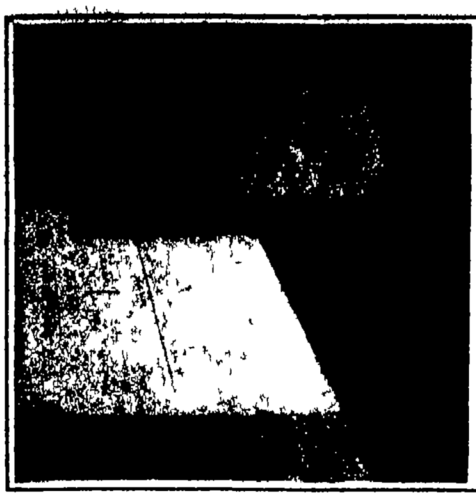
RIO DE JANEIRO'S first fruit exposition was opened on January 30th, and closed on February 7th. It was the result of the combined work of the director of the Commercial Museum of that city, who has been the chief promoter and the officers of several agricultural societies.

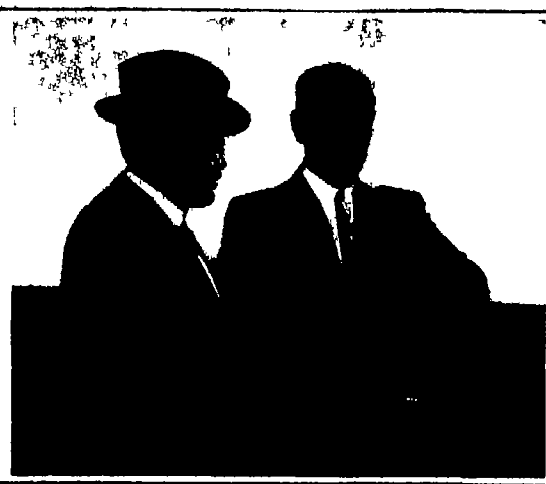
The chief object of the Brazilian fruit exposition was to initiate an effort toward bringing the producer closer to the consumer, and thus cut down materially the abnormally high price of fruits in that country, as well as to extend the trade in native products. With but one exception—that of the local representative of a California raisin firm, who presented a line of California dried and canned fruits that attracted much attention—the exhibits were all of Brazilian native fruits. Among the latter were mangoes, grapes, figs, dates, "mamão" (papaya), "cajú" (cashew) lemons, sapoti (sapodilla), bananas, guava, "jaca" (durrian), and peaches, apples, and pears from Southern Brazil. Most of the fruits just mentioned are common in Brazil, but the exhibits of such fruits as peaches, grapes, apples, and pears are indicative of real interest among the Southern Brazilian States in the cultivation of products for which the country has been dependent upon the United States in the past, and still is at present.

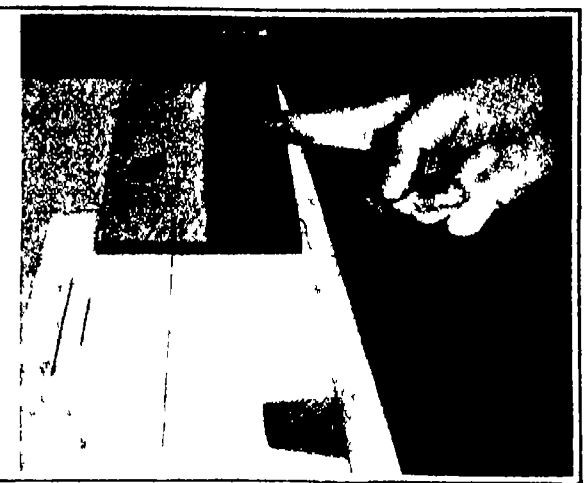
The U. S. Bureau of Standards and Engineering Abroad

INCIDENTS in the daily routine of the United States Bureau of Standards point to the constantly increasing recognition that is accorded in all parts of the world to the comprehensive and authoritative nature of the activities of this important branch of the Government service. There are requests for results of investigations, for scientific publications of the Bureau, for information on a seemingly infinite variety of subjects. A single day's record of correspondence received is evidence of the world wide appreciation of American work upon standardization, and research on problems connected with standards and the determination of the properties of materials.

Inquiries were received from China, Hungary, Australia, New Zealand and Peru during one day recently. The civil engineer in charge of the municipal laboratory for testing building materials at Shanghai asked for the results of the Bureau's investigation of the value of fine grinding of Portland cements by granular analysis. A request was received from the Royal Hungarian Central Office of Weights and Measures at Budapest, Hungary, for an exchange of weights and measures publications between the two governments. The Australian Statesman and Mining Standard of Melbourne desired to purchase two copies of the Bureau's circular on household measurements and also its publication on the metric system. The chief of the electrical laboratory, Peruvian Government's Special School of Engineering, at Lima, asked for a publication containing detailed specifications and materials for constructing standard Weston cadmium cells.


Inking the thumb before making a print


Taking the impression of a finger


Rolling the index finger upon the ink slab

The Origin, Classification and Uses of Finger Prints*

An Ideal System of Identification for the General Public

By Sergeant Frederick Kuhne, Bureau of Criminal Identification, Police Department, City of New York

DURING the last few years numerous articles have appeared in various magazines and newspapers relative to the identification of individuals (principally criminals) by the method known as the "Finger Print System," with no intention of the writers of such articles to convey to the public the information as to the manner in which finger prints are classified and identifications made, nor as to the value of finger prints in cases other than criminal

When finger prints were first adopted as a means of identification under a system of classification whereby a print could be filed and readily found the subject was treated as a science and made to appear technical and difficult. This was done perhaps to keep it confidential for police purposes, no thought having been given to its future possibilities or to the fact that a system, the use of which is indispensable to the Departments of Justice all over the world would make an ideal system for any institution, department, bureau, firm corporation, etc, desiring to prove identity or prevent impersonation

In order to interest the public in this comparatively new system an endeavor will be made to cover the omissions of previous articles by explaining the finger print system as concisely as the subject and space will permit by showing that there is nothing difficult or mysterious about the system and how valuable it would be, not only for the police, but for themselves, if everybody had their prints taken and filed for future use

The only requirements for proficiency in the knowledge of finger prints are ordinary intelligence and practical experience

Origin

According to the record of researches by prominent criminologists, the individuality of the finger print, or better known as the thumb print, and its value in proving identity was discovered by the Chinese over 200 years B C, an impression of the thumb being used by them in lieu of their signature in all legal and business transactions later this method was also adopted in India, and while from time to time various systems for the classification of impressions were advanced, they were not considered until the English government, realizing its value, adopted the "Henry System" in 1901. Since then finger prints under some system have been installed by the police of all the principal cities throughout the world

A Finger Impression

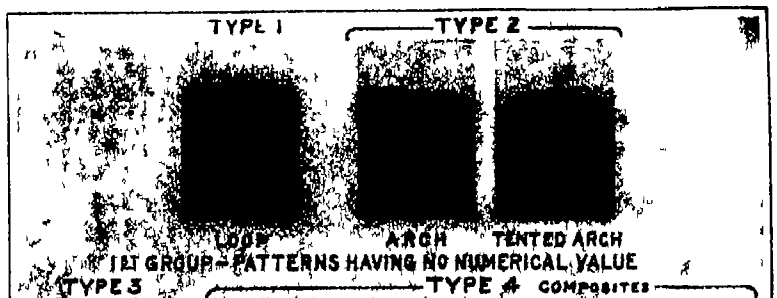
Before entering upon the explanation of classification, I wish to instill into the minds of those not familiar with the finger print work, the real meaning of a finger print or impression.

The dictionary defines the word impression as being the mark, or a mark of anything, such as a stamp, mold, etc., but as a mark made with the finger is not necessarily an impression and valueless to experts unless it shows the peculiarities of the ridge formation upon which the classifications and identifications are based, it fails to convey the real meaning.

The term finger print or impression, as used by experts, means the reproduction of the ridge formation on the bulb surface of the outer or nail joint of the finger in any manner whatever whether it be made with ink blood or the greasy substance which is emitted by the sweat glands the outlets of which are situated on the summits of the ridges whether it be a photographic reproduction or printed by means of what is known as a line cut, or whether impressed in clay, wax putty etc All are impressions within the full meaning and can be used by experts in making identifications A smudge made with the finger would be a mark but no impression in accordance with the finger print system

Classification

Although there are various systems for the classification of finger prints, such as the Conley, the Flak Conley" (an improvement on the Conley) and the French System,' the system I am about to explain is the Henry System which is the one most universally adopted Any person who acquires experience enough to be recognized as an expert can create a system of his own, which accounts for the variety of systems



The "Henry System" of classifying finger prints

All systems are based upon the peculiarities of the ridges, such as their formation into various patterns (by which the primary classification is determined), and by the formation of two fixed points (known as core or inner terminus and delta or outer terminus), together with the ridges intervening and surrounding these two points (by which the sub-classification and in some cases the final classification, is determined)

All impressions are divisible into one of two groups, of four types and eight distinct patterns, the first group being patterns to which no numerical value is assigned (except as explained later) consisting of two types and three patterns, such as loops, arches and tented arches (tented arches being included under the type of arches) the second group being those patterns to which a numerical value is assigned in accordance with their position in a set of prints and consisting of two types and five patterns, such as whorls, twinned loops, lateral pocket loops, central pocket loops and accidentals, the last four patterns being classed as composite

A set of finger prints (ten fingers), consisting wholly of patterns to which no numerical value has been assigned (first group) is given a primary classification of 1 over 1 expressed in the form of a fraction as ½ 1/1 ¾ etc for impressions consisting wholly or partly of patterns with a numerical value (second group), the primary classification is determined in the following manner

The ten fingers are divided into five pairs (the first finger of each pair representing the denominator of the fraction and the second of each pair the numerator) the *first pair* being the right thumb and right index finger with a value of 16 for denominator if appearing in thumb and 16 for numerator in index *second pair* the right middle and right ring finger with a value of 8 for denominator in middle and 8 for numerator in ring finger *third pair* the right little finger and left thumb with a value of 4 for denominator in right little finger and 4 for numerator in right thumb *fourth pair* the left index and middle fingers with a value of 2 for denominator in index and 2 for numerator in middle finger *fifth pair* the left ring and left little fingers with a value of 1 for denominator in ring finger and 1 for numerator in little finger, the value of 1 which as previously stated is assigned to prints consisting of patterns having no value is always added to the result obtained by the addition of the values as assigned to patterns of the second group, so as to account for the 1 which is borrowed for such prints The following examples will show how the values are applied and the primary classifications determined

If the right and left thumbs were both patterns of the second group and the other eight fingers of the first group irrespective as to which pattern the result would be 16 plus 1, giving 17 for the denominator and 4 plus 1 giving 5 for the numerator thus we have the primary classification of 5 over 17 for impressions in which both thumbs are represented either by a whorl, a twinned loop, a lateral pocket loop a central pocket loop or an accidental, if the right thumb right ring right little, left index and left little fingers were represented by patterns of the second group, the primary classification would be 10 over 23 When the ten fingers are considered under the same conditions the classification is the result in addition of 16 8 4 2 1 plus 1 for both numerator and denominator or 32 over 32 By this arrangement of values we have the square of 32 or 1 024 primary classifications, running from 1 to 32 over 1 1 to 32 over 2 1 to 32 over 3 and so on up to 1 to 32 over 32.

The primary classifications are further subdivided by the use of letters as A for arch T for tented arch, R for radial loop U for ulnar loop for patterns of the first group in the index fingers and I for inner M for meet O for outer determined by tracing the ridges of patterns of the second group but as this part of the system is very lengthy I will not attempt to explain it in detail owing to limited space

Prints with a loop appearing in the right little finger would have what is termed a final count or classification in the form of a numeral representing the number

(Concluded on page 365)

* Finger Print Instructor, by Frederick Kuhne Munn & Co Inc., Publishers.

The Heavens in April, 1916

Remarkable Surface Features of the Planet Mars

By Prof Henry Norris Russell, Ph D

WHILE Mars is still conspicuous in the evening sky, we may well continue the discussion of the planet's remarkable surface features Reasons were given last month for believing that the great differences between the drawings of the planet by different observers arise from what is technically called personal equation —that is from differences in their visual and mental perceptive apparatus operating unconsciously and that while a multiple of faint and difficult details undoubtedly exist on the planet s surface the only way of deciding which of the various types of drawings are probably most like the reality is by means of test observations on artificial planets ' which have never yet been made with sufficient comprehensiveness to answer the question

We may now consider the principal explanations which have been suggested for the observed details, or, rather, for the changes to which they are subject, for the mere existence of permanent markings of various shapes, sizes and colors on Mars would be no more surprising than on the Moon's surface or anywhere else

The most conspicuous of all the changes—those of the polar caps—are the easiest to understand From the way in which they shrink in spring and summer, and reappear again in late autumn it seems practically certain that they must be deposits of snow or frost of some kind—deposited on the surface as the winter's cold approaches and melting away or evaporating as the warmth returns

Since the material which disappears from one cap evidently goes in part at least, to form the other, the planet must have an atmosphere through which the vapor of the material forming the caps is carried from pole to pole The existence of an atmosphere is confirmed by several other lines of observation notably by measures which show that there is a certain amount of twilight on Mars after the sun has set, just as there is on the Earth.

The composition of the atmosphere and of the polar caps is harder to find out, and the existing data are puzzling The most obvious suggestion is that the white stuff at the poles is actual snow or hoar frost—frozen water, in some of its familiar forms The only difficulty about this view is that, so far as can be determined from existing data, it is very hard to see how the surface of Mars can get hot enough even in summer, to melt snow—or even reach the temperature, perhaps not far above zero Fahrenheit at which snow begins to evaporate slowly into perfectly dry air, just as camphor does in a warm room

An alternative idea is that the caps consist of "carbon dioxide snow"—the white flocculent solid into which this gas condenses at a temperature of about 80 degrees Centigrade, or 112 degrees below zero Fahrenheit But here the difficulty is the other way, for it is equally hard, or harder, to see how the surface of the planet can be cold enough to permit the existence of solid carbon dioxide through the summer, or to allow it to form again as early in the Martian autumn as the white deposit actually does

In the opinion of the present writer, after a careful examination of the data, the question must be left unsolved for the present.

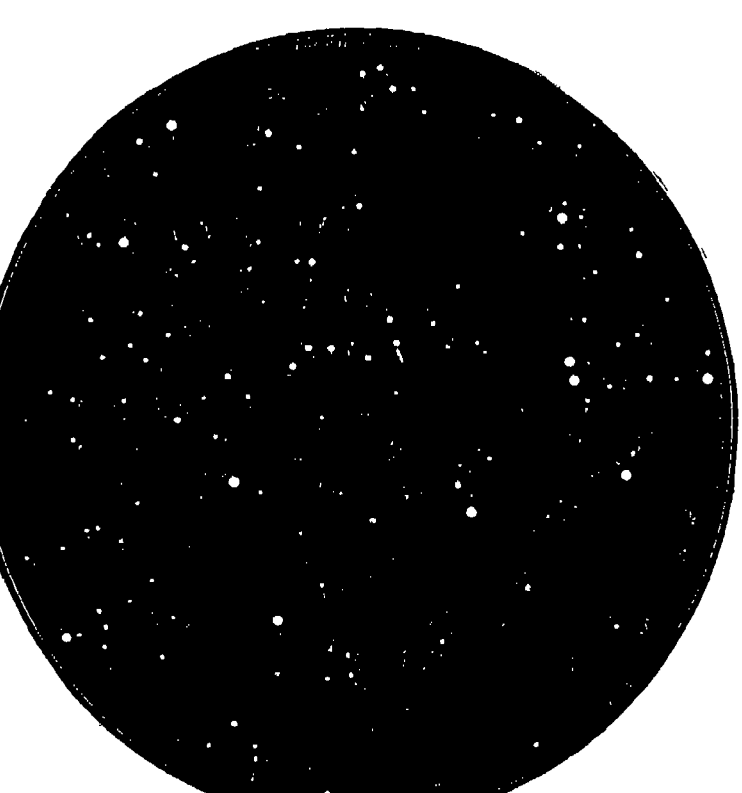
Only one thing seems certain the polar caps must be very thin for they sometimes disappear completely in summer Now the whole amount of heat received during a Martian summer would suffice to melt and evaporate a layer of snow (or of solid carbon dioxide, for that matter) only a few feet in thickness. Since most of the heat actually received must be lost again by reflection or radiation into space, the thickness of the polar caps must be very small, probably averaging only a foot or so

All the evidence goes to show that the planet's atmosphere, also is far less extensive than the earth s It is hardly safe to make a numerical estimate but the assumption that there is one tenth as much atmosphere above a square mile of the surface of Mars as above an equal area on earth seems a rather liberal one. Regarding the composition of this atmosphere there are indications, from certain difficult and delicate spectroscopic measures, of the presence of water vapor and oxygen, but other measures by fully as trustworthy methods show no perceptible signs of them And the quantity present must at most be very small

We may now take up the most interesting problem—the nature of the dark areas and of the "canals ' The former are certainly not seas, as was once supposed—a sufficient proof being that the brilliant reflection of the sun from the surface of the water which in that case would be conspicuous, has never been observed

A widely held opinion—and one which is entirely plausible if the planet's temperature gets above the freezing point of water, and the polar caps are composed of ordinary snow—is that these dark areas are regions of vegetation scattered over the otherwise desert surface of the planet

The enlargement and darkening of these areas in the local summer, when the moisture from the melting polar snows reaches them (whether by streams, rain or dew) is just what might be expected, while their shrinkage in autumn and winter (when the air becomes very dry again) and the change of color in some places from green to brown are equally easy to explain



At 11 o clock Apr 7
At 10½ o clock Apr 14
At 10 o clock Apr 22
At 9½ o clock April 30
At 9 o clock May 7
At 8½ o clock May 15.
At 8 o clock May 22.

NIGHT SKY APRIL AND MAY

This is a very attractive theory, but is by no means the only one which can explain the observed changes For example, Arrhenius, guided by the behavior of certain desert regions in Persia and elsewhere, has suggested that the dark areas may be alkali flats, where the sand is full of hygroscopic salts Whenever there is much moisture in the atmosphere these salts will absorb it from the air, and form a brine which will moisten the sand and make it look dark, but when the atmosphere becomes very dry (all the available water being locked up in the growing polar cap) the water will evaporate again, and the dissolved salts will effloresce, leaving the dry surface covered with a whitish or yellowish deposit

Other explanations, not involving the presence of life, could doubtless be devised, and in all probability some of these chemical explanations could be adapted to the hypotheses that the substance whose vapor diffused from the polar caps into the atmosphere was not water but something else of lower melting point

On the vegetation theory, the canals are explained as fertile strips of land bounding watercourses which cross the deserts This does not prove them to be artificial for, as Professor W A. Pickering the originator of this idea has pointed out, the valley of the Nile, seen from the moon, would appear as a green streak crossing the great yellow area of the African desert

As in this terrestrial case, the watered region may be many times wider than the watercourse itself

The progressive darkening of the canals after the polar cap shrinks, beginning nearest it and extending gradually outward to the equator and beyond it, can then be explained as the result of the progress down them of floods of water from the melting snow, and the subsequent growth of vegetation—as happens, indeed, in the case of the Nile

Dr Lowell, starting with this explanation, argues further that the canals form so remarkable a geometric network of fine, sharp straight lines that they cannot have arisen from the casual operation of natural forces, but must be artificial, and the products of great engineering skill He reasons also that, since the water flows away from the polar cap in all directions along different canals at about the same rate, and goes a long way beyond the equator (as indicated by the darkening of the canals), while six months later, by the Martian calendar, it flows along these same equatorial canals in the opposite direction, it cannot flow under the mere force of gravity, but must be artificially conducted, in a word, *pumped*—which shows that the designers of the canals have not become extinct, but are still using them for irrigation

To develop arguments which show that it would be possible to get evidence of the existence of intelligent inhabitants upon a planet fifty millions of miles away is an admirable piece of constructive reasoning There is moreover, nothing in our present conclusively established knowledge of Mars which is irreconcilable with Dr Lowell s theory, but it should nevertheless be borne in mind that some of the most important bases upon which it is established are not to be counted as conclusively settled by observation and that it is in any case not the only possible explanation of the phenomena

It has already been shown that the exact geometrical character of the canal system is very far from being proven, and with this, the argument for the artificial character of the system loses its cogency Again, and more fundamentally, it is not certainly established that vegetation exists on Mars, or even that the polar caps are of frozen water, and that it ever gets hot enough to melt them

If they do supply the planet with water the alkali mud theory will account for changes in the color and visibility of canals as well as of larger areas, and, as Law has suggested, the progressive appearance, first of the canals nearest the pole and then of those farther away, may be explained without invoking intelligent action by assuming that, as the polar caps melt a thin haze spreads over the surface, concealing the full details, which finally clears, starting at the pole, so that the canals, which have all darkened, invisibly to us, under the hazy covering, come into view successively, as reported by the observers.

When all these possibilities are considered, the writer, for his part, is loath to make dogmatic statements concerning Martian problems The explanations here very briefly outlined have been suggested to their advocates very largely by analogy with features of the Earth's surface. If we could be equally familiar with the conditions prevailing on other bodies, we might well be led to still different, and equally possible, theories concerning Mars, and find ourselves more embarrassed than ever to choose between them, until more distinctive observational data became available.

The Heavens

The appearance of the sky in the latter part of an April evening is shown in our map Almost overhead, but a little to the north, is the Great Bear The "Pointers" in the bowl of the Dipper point downward to the Pole Star, and beyond it to the zigzag line of Cassiopeia, low on the horizon. To the right of these, in the northeast, is Draco, coiled about the Little Bear Low in the northeast is the bright star Vega Above this are the quadrilateral in Hercules, the semicircle of Corona, and the resplendent Arcturus. Virgo is well up in the south. Its brightest star, Spica, makes a fine triangle with Arcturus and Denebola in Leo

(Concluded on page 362)

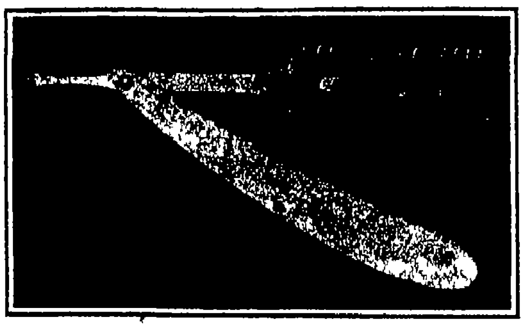
Inventions New and Interesting

Simple Patent Law; Patent Office News, Notes on Trademarks

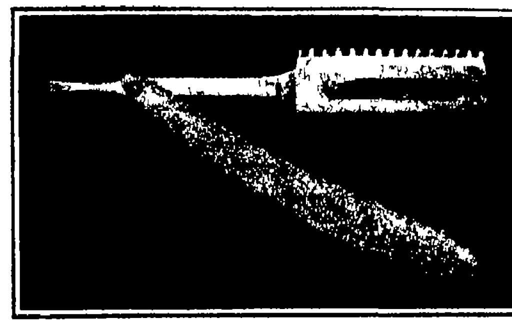
Surgical Scalpels with Detachable Blades

FOR the past three or four years, or ever since Dr Murphy, of Chicago, conceived the idea of attaching a safety razor blade to a scalpel handle for an operating knife, there has been considerable discussion among the surgical profession relative to a scalpel provided with a thin, wafer like blade similar to those used in safety razors.

While the exceedingly sharp edge of the razor blade recommended it for surgical purposes, since the healing of a wound from a keen knife is more satisfactory than that from a dull knife, still, its shape was not satisfactory, the square corners and straight cutting edge making the manipulation of such improvised scalpels most inconvenient This obvious disadvantage was overcome in a number of inventions subsequently developed, providing surgical scalpels with detachable blades of the proper shape or rather, better shaped for the purpose For certain reasons, however, these new instruments did not seem to find great favor with the surgical practitioners, perhaps the main reason was that in addition to the handle and blades, other parts were used in their construction, creating crevices and joints, all of which made the article either impossible to sterilize without taking it apart or difficult to maintain antiseptic Hence these scalpels were limited in their uses owing to inherent imperfections, in spite of the obvious advantages of the principle employed



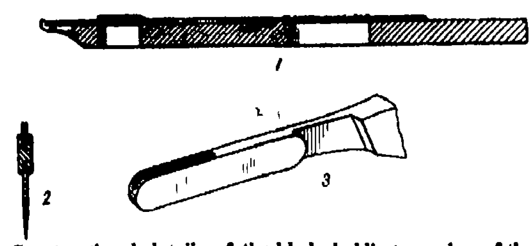
Recently invented safety razor with the blade removed, showing the lugs



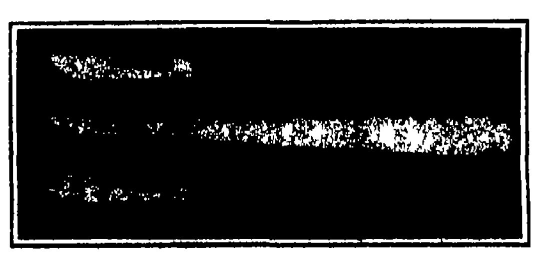
New type of safety razor with the renewable blade held in position

There has recently been invented a form of scalpel with detachable blades, which appears to solve the problem in a most practical manner Not only are the blades of the proper shape, but they are so made as to be readily placed on the scalpel handle and firmly held thereon without the use of a clamping device In fact, the construction of the new scalpel is no more complicated than the ordinary instrument.

The inventor of the new scalpel, Morgan Parker of Newport, R I, has made use of the spring flexibility of thin steel blades in an ingenious manner for holding them on the handle. The device makes use of the spring characteristic as the stage through which the blade must pass in order to gain its position on the handle This is accomplished by automatically causing the bending of the blade while attaching which again snaps straight when in position, making it immovable from the handle until again sprung, resulting in the elimination of all moving and accessory parts and reducing the instrument to a handle and the blades Thus the blades are made to slide onto the handle and snap into place, and are as readily removed in the reverse order, by a simple manipulation of the fingers The construction of the new scalpel is such that a blade cannot be dislodged except when so intended by its user, and when in position on the handle, it is held rigidly in order that it may not be over flexible while in use



Constructional details of the blade-holding member of the new surgical scalpel

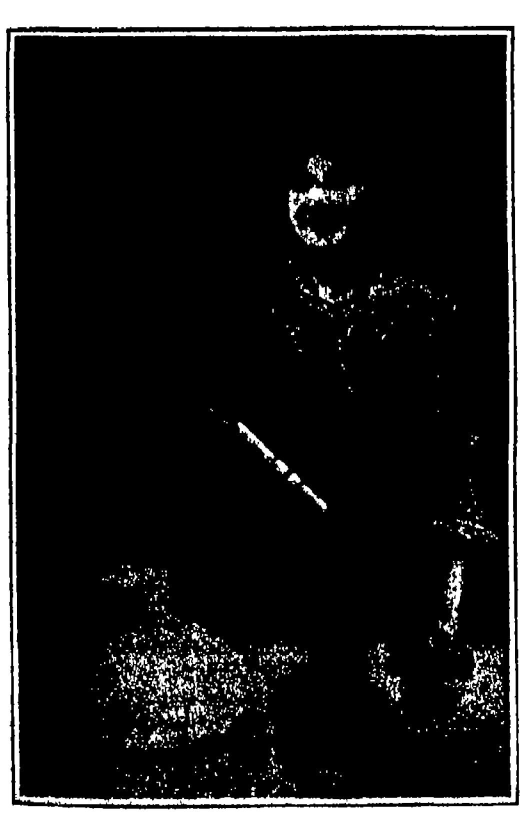


Surgical scalpel of simple design and its renewable blades

With the new scalpel, fresh blades are available for each operation insuring a sharp and perfect edge Furthermore, the time and trouble incidental to the resharpening of the regular scalpel blades are eliminated, for the cost of the blades is low The instrument lends itself to sterilizing just as readily as the conventional scalpel

Mr Parker has also perfected a type of safety razor made along the same general lines as the usual razor but provided with a guard and renewable blades Here again the flexibility of the blades has been made use of A long slot is cut in each blade serving to hold this member on the back of the guard by engaging with two ears of different lengths To insert a new blade in place, it is slightly bent while engaging with the first or long ear, but snaps back into shape when pushed far enough and is then shifted so as to engage with the second or short ear, resulting in its being held firmly in place The reverse operation is followed to remove the blade

Although the razor just described is of the utmost simplicity comprising but three parts—the handle the guard which is provided with the holding ears as integral parts and the renewable blade—still it has practically every desirable feature possessed by other safety razors it is inexpensive readily cleaned and efficient



Converting an ordinary kerosene oil lamp into a gas lamp, using the carbide candle

Carbide Candle Instead of Kerosene in Oil Lamps

DUE to the European war there have been very few practical novelties developed during the past year and such novelties as have appeared have had some connection with the war in nearly every instance This is the case with the German carbide candle device shown in the accompanying illustration

The new carbide candle is made in two sizes, for 10 and 14-inch burners and can be applied to any lamp after the removal of the kerosene burner, by means of the movable socket Thus there is furnished a new sort of lamp which provides a cheap means of illumination where kerosene is lacking

The operation of the carbide candle is simple After the removal of the bottom cover the candle is filled with about 75 grams of carbide and the cover replaced The kerosene container of the lamp on which the candle is to be used is then half filled with water The candle is placed in the font of the lamp and at the end of about a minute a constant supply of acetylene gas issues from the burner It is advised that the candle be placed in a glass tumbler first before placing it in the font of a lamp in order to make sure that no gas escapes from the screwed on bottom After being thus charged and prepared the candle can be used for a considerable period of time until the carbide is exhausted

When too much water is absorbed into the carbide candle, the flame becomes too large Conversely the flame will be too small when the carbide tends to form mud or slime at the bottom These conditions however, are soon regulated and after a brief use can be avoided without trouble Obviously the duration of one charge depends upon the size of the candle The carbide used costs on the average about one pfennig per hour in Germany where the device has been invented and widely introduced since the beginning of the war When the carbide is exhausted in the candle there remains a chalk like residue in the holder, which is easily loosened when dry by a spoon handle or other utensil If it is necessary to refill hastily the residue may be removed while still moist but since in this case gas may still be forming great care must be exercised not to come too near another light

Use of Periscope for Purposes Other Than in Warfare

MUCH has been said of the extensive use of periscopes both by submarines running below the surface of the water and by soldiers in the trenches However, the periscope has heretofore figured but little in the peaceful walks of life

Recently a large crowd gathered outside the War Office in London for the purpose of seeing Lord Kitchener just before he started for the front. One man, fearing that he would be unable to secure a glimpse of the famous British general, brought with him a periscope of the variety used by the British soldiers in the trenches in Flanders Needless to state, this optical device enabled him to secure a field of vision over the heads of the people surrounding him

Using a periscope in a crowd in order to get a glimpse of General Kitchener

Preparedness for Peace in the Mineral Industries

(Concluded from page 351)

The Bureau of Mines is experimenting with new methods by which it is believed this loss can be reduced to 10 or 15 per cent

The uses of bismuth are growing, and if the metal could be obtained more cheaply, these uses would be greatly increased Probably 4 000 pounds of this material is going daily out of the stacks of the smelters in the western states

Many of the rarer metals have a great importance in their relations to the industries of the country and to human comfort. A very important group of the steel alloying metals includes chromium, cobalt, nickel tungsten, vanadium, molybdenum, and titanium By the use of these wonderful alloy steels, largely developed in the United States one man now does as much work with metal-cutting machinery as could formerly be done by five men Tungsten besides its use in steel, in which it is saving millions of dollars a year in wages is saving other millions of dollars to consumers of electric light Incandescent lights with tungsten filaments furnish for 15 cents as much electric light as one could get ten years ago for one dollar and of much better quality There still are opportunities in the metal lurgy of tungsten.

Uranium is chiefly notable from its being the parent of that wonderful element, radium The Bureau of Mines in connection with the National Radium Institute has manufactured radium on a commercial scale from the carnotite ores of Colorado at a cost one third the price asked by foreign producers This triumph of American skill and invention is not only making this country independent of foreign sources of supply, but is enabling American physicians to apply to the cure of cancer radium in quantities not available to physicians in Europe

Practically all the potash salts used in the United States have come from Germany the imports amounting to $15 000 000 annually To remedy this situation, the Government has been actively engaged in investigating as possible sources of potassium salt saline residues natural and artificial bitterns alunite and similar minerals, the igneous rocks and minerals like the potash bearing feldspars the greensand marls, and organic sources such as seaweed molasses residue wool scourings etc Experiments indicate that the United States may soon be relieved of absolute dependence on foreign resources of potash salts

The waste in mining phosphate rock is large in the Florida pebble field being probably two or three times the tonnage of rock saved Among the possibilities of the future are the introduction of chemical methods whereby low grade deposits can be converted into concentrated forms and shipped at a profit, the direct application of low grade phosphate rock to the land, and the utilization of other sources of phosphate, for example, the mineral apatite and phosphate-bearing slags, large quantities of the latter now being wasted

We are entirely dependent on Chile for our natural nitrates, the imports from that country in normal times amounting to about $20,000 000 annually Nitrates are being made from the nitrogen of the air by electrolytic processes on a small scale in the United States, and successfully on a large scale in Norway Our wastes of nitrogen, in normal times worth in combined form about 15 cents per pound, are almost inconceivable. Although we coked in a recent year over 63,000,000 tons of bituminous coal, we recovered only $3,800,000 worth of the $22,000 000 worth of recoverable nitrogen contained in the coal This we can charge to the wasteful beehive coke-oven

Through the inventive genius of an American, Herman Frasch, the United States occupies the dominating position in the sulphur industry of the world. Methods are now extensively employed in the manufacture of sulphuric acid from smelter gases, the production of acid in this way in 1914 amounting to [illegible] tons, the remarkable growth of a profitable industry from what was a nuisance and a waste product. Pyrite, the mineral used primarily in making sulfuric acid, is a by product in coal mining in several states. Formerly it was discarded, but in 1914 31,500 tons, valued at $84,000, were produced in three states.

One of the largest of our imports is pottery, the import value of which in a recent year amounted to more than $11,000 000 There is little doubt that a careful study of our own deposits and methods of preparation would enable us to utilize domestic material more extensively Investigations by the Bureau of Mines indicate that an immense tonnage of the purest known semikaolinized feldspars is available in the southern Appalachian region

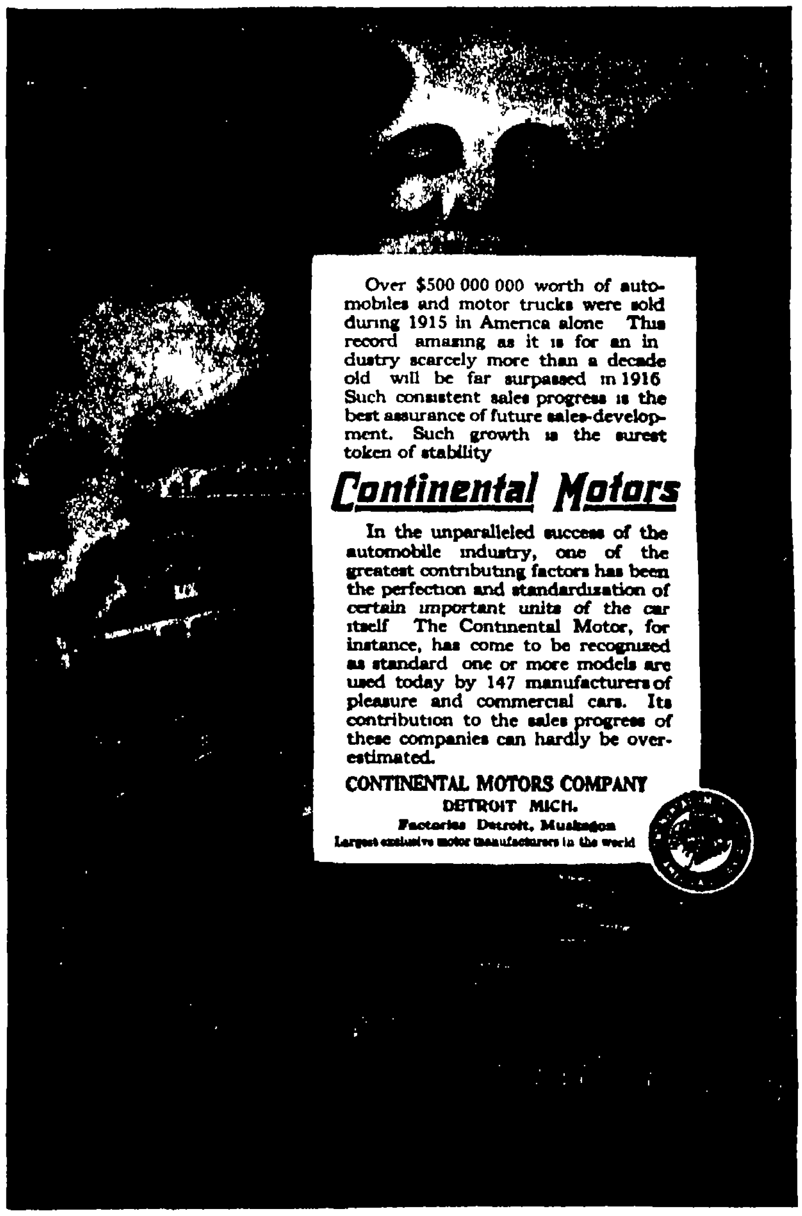
The growth of the Portland cement industry in the United States has been one of the wonders of modern industry In 1880 there were produced in the country 85,000 barrels, in 1913 more than 92,000,000 barrels, valued at as many dollars. There seem to be excellent reasons for stimulating the export trade to South America Although this exporting may not promise large direct profits, the creation of such a trade should benefit the industry through the opportunity to dispose of surplus stocks A serious loss at cement plants is in the flue dust, ranging from 4 to 10 per cent of the raw material A plant at Riverside, California, has installed the Cottrell process for catching its dust, which was injuring surrounding orchards and has found that great quantities of potash had been going to waste, the value of which, now recovered, is nearly as large as that of the cement produced

The United States produces more than two thirds of the fuller's earth it consumes, and when it is considered that prior to 1895 there was no regular production the progress of the industry has been remarkable Many samples of American earth are distinctly superior in bleaching power to the English earth, and the investigations of the Bureau of Mines show the domestic earth to be better suited for refining edible oils than the imported product.

Bromine produced in West Virginia and Ohio, is largely shipped abroad and returned to the United States in the shape of fine chemicals, for which we pay the costs The large quantities of calcium chloride formerly wasted in the manufacture of soda are now being used in part, and it is hoped that new uses for that which is now wasted will soon be found

Comparatively little is known about a large number of the rarer elements, especially tantalum, columbium, thallium, thorium, beryllium, and the twenty or more elements of the cerium and yttrium earths No one can say what an exploitation of this field might lead to, but it is through scientific investigation of such problems that many industries have been developed, perhaps the most noteworthy being that of the Welsbach gaslight mantle There is reason to believe that a more general manufacture of thorium nitrate, the important chemical product necessary for the manufacture of incandescent mantles, may be developed in this country There are deposits of monazite in many states, and with the knowledge that a valuable material—mesothorium—can be made as a by product, the industry should pay well. Mesothorium is used successfully in therapy in the same manner as radium.

From our copper refineries and sulfuric acid plants at least 300,000 pounds of selenium is going to waste each year Selenium is the only known element having an electrical conductivity that varies with exposure to light, and this property will undoubtedly give the metal special prominence in future. Tellurium is also going to waste in quantities. No present use of importance is known for the element, although it is obtainable at a low price. Silicon, next to oxygen, is the most abundant of all elements, and until recently has been obtained only as a chemical curiosity. It has remarkable powers of resistance to all ordinary weathering [illegible]



and except for its brittleness would probably find extensive use

The United States has an ample supply of crude barytes, the mineral used in the manufacture of white paint, rubber, artificial ivory fireworks, etc Yet because of imperfect methods of mining and treatment of American ores, we have depended on Europe for this material Since the war began, however, barytes compounds are being manufactured in several states The new industry is not only meeting the domestic demand but is also furnishing large quantities for export.

As a consequence of "strain breaks" resulting from rock stresses, heavy losses have been entailed in marble quarries The Bureau of Mines has lately devised a method of relieving the rock pressure so as to prevent destructive fracturing and great masses of valuable marble that would otherwise be wasted are now being utilized

Large areas of peat of considerable value lie near great iron mines in northern Minnesota which are now being worked entirely with coal brought from a thousand miles away This peat could be used to replace the coal for generating producer gas or steam in large power plants in such a way that the by product of ammonia recovered should pay the entire cost of plant operation, and thus the producer gas, an excellent fuel for engines be obtained free of cost

The Heavens in April, 1916

(*Concluded from page 358*)

Hydra, Crater and Corvus are visible in the southwest, and Gemini, Canis Minor and Auriga in the west and northwest.

The Planets

Mercury is in conjunction with the sun on the 14th—behind it—and is practically invisible except at the very end of the month when he sets about an hour and a half after the sun He is then in Aries, not near any bright star, and should be easily identifiable in the twilight.

Venus is evening star in Taurus and is exceptionally bright and conspicuous She reaches her greatest elongation (or apparent distance from the sun 45° 39′) on the 24th, and is at the same time in a very high northern declination—nearly 27° The combination of these two things keeps her in sight until 10 45 P M, while early in the evening she is more than 30° above the horizon At the same time she is nearly, though not quite at her greatest brilliancy being 100 times as bright as a standard first magnitude star She is so bright that she casts a shadow, which may very easily be seen by going into a room into which no artificial lights, such as street lamps can shine and letting the light of the planet come through a western window and fall on the opposite wall

Mars is in Cancer, but has reversed his motion, and is swinging back into Leo at an ever increasing rate He is 85 million miles distant at the beginning of the month, and 108 million at its close, and is growing smaller in the telescope, and fainter to the eye, but he still looks brighter than a first magnitude star

Jupiter is in conjunction with the sun on the 1st, and can be seen only at the end of the month, just before sunrise Saturn is an evening star in Gemini, remaining in sight till about midnight.

Uranus is a morning star in Capricornus, and Neptune an evening star in Gemini.

The moon is new at 11 A M on the 2d, in her first quarter at 10 A M on the 10th, full at midnight on the 17th, and in her last quarter at 6 P M on the 24th. She is nearest us on the 20th, and farthest off on the 9th During the month she is in conjunction with Mercury on the 1st, Jupiter on the 2d, Venus on the 6th, Saturn on the 9th, Neptune on the 11th, Mars on the 12th, Uranus on the 25th, and Jupiter again on the 30th.

Neuimin's Comet

A faint comet was discovered photographically by Neuimin, at Simeis, Russia, on February 24th—just after the last of these articles was completed.

It was then in the southern part of

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Cancer, and moved slowly southeastward into Hydra

Two orbits have so far been computed, one by Castro at Santiago, Chili, the other by students of the University of California. They agree in showing that the comet came to perihelion early in March, and that it is moving in an orbit but little inclined to the ecliptic (one computer finding 10° and the other 17°) and in the same direction as the earth

The perihelion distance is 1.58 times the earth's distance from the sun, according to the first set of elements, which were computed on the usual assumption of a parabolic orbit The California computers find that the orbit is elliptic, with a perihelion distance of 1.83, and the short period of 5.2 years, but describe the computed value as still uncertain, owing to the short time available for observation.

According to the ephemeris based on the latter elements, the comet on April 1st should be in about 9 h 26 m R. A. and 2° declination—that is, about 6° north of Alpha Hydrae—and moving southeast about half a degree per day It is receding from the sun and growing fainter and will probably be visible only in large telescopes

PRINCETON UNIVERSITY OBSERVATORY
1916, March 20

War Game—III

(Concluded from page 353)

Answers to Questions in War Game II

Question 1 The situation of the Advance Guard is indicated on accompanying map

Question 2 The outpost line, with supports and reserve, is shown on map. The reason for selecting this line for the outpost is, first of all, the fact that the most likely approaches from the north are secured against the advance of enemy forces, thus giving full protection for the main body

Especially during the night is it a very hazardous task for any force to leave the roads, therefore, the occupancy of the approaching roads must be given first consideration. The outguards not located on roads form a protection against possible smaller harassing enemy parties, and, in this open country, make it almost impossible to disturb the rest of the camp

The assigned outpost line is an ideally good line for this service The section covered by A Company is an almost perfectly clear country with good supporting points, while B Company has an even more advantageous section on account of the natural barrier formed by the Conestoga Creek

By sending out patrols as indicated by arrows the security will be further improved

Questions 3 and 4 See map for answer

Question 5 The commander of B Company gives the following order

"Considerable enemy forces have been reported 14 miles north, near *coal mines* Our detachment will camp for the night in *Norrisville* Our battalion will establish outpost on line *Clan Road* to *Bowers Bridge* In case of attack this line will be held

"This company as Support No. 2 will guard the section from the western slope of *Goat Hill* to *Bowers Bridge*

"Five outguards will be sent out and one special patrol

"Sergeant S/1, with one squad, on slope of *Goat Hill* between bridge and hilltop

"Sergeant S/2, with two squads, on *Conestoga Bridge* on road

"Lieutenant L, with two squads, on railroad bridge

"Corporal C/1, one squad between railroad and *Bowers Bridge*

"Patrols to be sent out by outguards Nos. 2, 3 and 5.

"One special patrol to Deansville.

"Communication to be maintained from right to left. Third and fourth platoons remain here as support.

"Reports to be sent here"

Occurrences of Importance.

At 7.35 A.M., the independent cavalry, Captain C, in order to delay the enemy, blew up railroad bridge spanning Tincum

Creek and, taking a position southwest from this bridge, partially sheltered by [illegible] opened fire upon the advance guard of the enemy.

The main body of the enemy immediately changed direction in order to gain other bridges, while their advance guard deployed and occupied stretch between railroad and Nehaminy River

At 8.50 A.M., enemy artillery opened fire from Chester Hill with two guns, upon squadron.

At 9:30, Captain C retired from his position to nearest edge of Pine Forest.

At the same time, our own artillery, from Lookout Hill, responded to enemy's fire.

* * * * *

The Fourth War Game will deal with the combat between these two detachments, first showing our own, then the enemy's action.

The Origin, Classification and Uses of Finger Prints

(Concluded from page 357)

of ridges in such loop between the two terminal points (core and delta), these two points being excluded from the count

Making Identifications

After the primary classification, subclassification and final classification (if any) of a print have been determined they are compared with the prints on file having the same classification by taking into consideration all the peculiar formations of the ridges and patterns in the print If they do not agree in the minutest detail they are not of the same person

As an experiment, take your own print by using an ink pad instead of printers' ink, and examine it under a magnifying glass and you will see the numerous characteristics of the ridges such as a single ridge separating into two ridges termed ridge bifurcation ridges that end abruptly, short ridge lines or dots etc, upon these points the identifications are based, they being exactly alike in duplicate prints, even though taken years apart.

How Used

Although finger prints are utilized with success in the Army and Navy Departments of the United States for the apprehension of deserters and to prevent the burial of soldiers as unknown in case of war and by a few savings banks for the protection of depositors who are unable to write, thereby preventing the withdrawal of funds by unauthorized persons its greatest success perhaps has been in the Police Departments where positive identifications are being made daily whether the person be alive or dead (good impressions of the dead being obtainable until decomposition sets in), irrespective of name, age, sex color or nationality

It also aids them in apprehending and identifying criminals who unconsciously leave their impression or impressions on some article at the scene of a crime, these impressions very often being submitted as the only evidence of guilt

When impressions of three or four fingers are unconsciously left, a classification is possible by considering each of the missing fingers under both groups of patterns; but where the impression is of one finger only this is not possible, as no system has been devised for its classification, nor do we know of a method to determine which one of the ten fingers it might be. When identifications are made of one impression, it is usually done in one of two ways, either by comparing the print with those on file of persons suspected of the crime, or by the arrest of some person charged with the crime, in which case the finger prints are taken and a comparison made. If no identification should be made at the time under either of the preceding circumstances, the impression is preserved for future use.

[illegible] Prints Could Be Used

[illegible] stated, the Police Department [illegible] identifications of the [illegible]

cations are only possible where the deceased person has been previously finger-printed for some crime or violation for which finger prints are authorized by law.

What a valuable file the police could control if the public would only realize the latitude of finger print possibilities and the benefits to be derived therefrom not only by themselves, but their families and relatives, if the police were equipped (by reason of having their prints) to identify all persons coming within their jurisdiction irrespective of circumstances, whether it be a criminal, a person who was murdered or killed accidentally, an unconscious person, or one suffering from aphasia. Would it not save them considerable anguish if the police were in a position to notify parents or relatives in all such cases?

The unsuccessful attempts of the police to establish such a file is due to the fact that there is no law compelling it, and that whenever mention is made of finger prints the majority of persons not familiar with the system connect it with criminals, forgetting that the individuality of prints is not limited to criminals and that prints differ from photographs, inasmuch as they cannot be identified except by a duplicate set of prints, and then only by an expert.

Let us take into consideration the "Slocum" disaster on Long Island Sound a few years ago, when hundreds of human lives (mostly women and children on a church outing) were lost by drowning. How easily the bodies could have been identified and the parents or relatives notified, how it would have saved them the disagreeable and heartrending task of visiting the morgue every day in an endeavor to identify the bodies of their beloved ones as they were brought in. By finger prints all this could have been avoided and identifications made in a short time whereas without them it required several days and even then a large number were buried unidentified.

It would also be an aid to the public in the collection of life insurance by supplying them with a positive proof of death of the insured which no insurance company could ignore.

The Hon Arthur Woods Police Commissioner of the city of New York, is heartily in favor of establishing a general file of finger prints for Greater New York, and I have no doubt that permission will be granted upon application for the taking of finger prints in duplicate, so that a copy may be retained at home for future use to all persons who desire to aid in its establishment. The only persons who could have good reasons to object to finger prints are those with criminal tendencies.

The possibilities of the finger prints are numerous and varied, as they can be adopted wherever identity is to be proven or impersonation prevented, either under a system or classification, for which the services of an expert would be required, or without a classification, as in places where fictitious names are not resorted to.

A very interesting case in which a lone finger print was the important factor, even though it was not used for the purpose of obtaining a conviction, was the arrest of one John Bernauer.

On the night of January 25th, 1914, some person (unknown at the time) entered and burglarized the home of J P Morgan, Jr, at 231 Madison Avenue, New York city, without arousing the occupants, and succeeded in securing loot to the value of several thousand dollars, leaving no clew save the impression of one finger on a cigar lighter, which the perpetrator of the crime had handled but left behind as valueless. This impression was photographed by the police and compared with the prints of various suspects on file at the Bureau of Criminal Identification with unsuccessful results.

This impression took the course as many others had done before and was filed for future reference, when on September 30, 1914, seven months after the Morgan burglary, Detectives Doyle, O'Neill, and Tierney, who had been shadowing Bernauer for [illegible] rested [illegible] was [illegible] have an [illegible] for a [illegible] surprise they found upon his person a match safe and several other articles with the initials J. P. M., Jr., but as they could not at the time of arrest prove him to be the thief, he was charged with having stolen goods in his possession, which is a minor crime.

At the time of his arrest Bernauer denied all knowledge of the burglary, stating that it was given to him to pawn by one Muller, who could not be located, but after he was brought to police headquarters, finger-printed and shown that the print on the cigar lighter and the impression on his right middle finger were identical, he readily admitted his guilt; thus the impression of one finger was the direct cause of charging him with the burglary (a felony) and for which he was sentenced to not less than five nor more than ten years in Sing Sing Prison by Judge Swann on October 29th, 1915.

In Europe provisions were made for the admission of finger-print evidence as relevant, and while no such provisions exist in the United States, the judges and juries generally accept it as such, as shown in the case of one Charles Connors, alias Ice Wagon Connors," who was arrested and convicted on evidence of a single print on the balcony railing of the home of Ernest R. Ackerman of Plainfield, N J, which was entered on January 3rd 1914, and jewelry to the value of $17 000 stolen. He was sentenced to serve from three to seven years, but as counsel did not believe the finger print evidence would hold his case was appealed, with the result that on June 22nd, 1915, the Supreme Court at Trenton, N J., confirmed the conviction and sentence, on the grounds that finger prints are proper and admissible as evidence.

A Successful Experiment in Skunk Farming

(Concluded from page 346)

skunks taken from the wild showed that for the most part the animals live on insects. Some were found to have dined off field mice, rats, squirrels and pocket gophers, carrion, lizards or salamanders, crawfish, fungi, earthworms, berries and fruit of various kinds. So fond are they of an insect diet that in the season when this provender is plentiful it has been found that they live on it to the exclusion of everything else. As the insect pest largely predominated in the stomachic contents of the skunks thus examined, the liking of the animal for grasshoppers, crickets, cicadas, army worms and such enemies of the farmer being apparent, the result proved that the skunk is a much maligned animal when he is classed among the wild things whose extinction would benefit the human family.

The skunk breeders take care that all the food they feed to their skunk family is well cooked, they claim this precaution is necessary to prevent stomach trouble. So they feed their colony on cooked vegetables and boiled horse flesh, with the remains of the family dinner and supper as a filler-in.

The captured skunk is rendered harmless by a simple operation. This operation sometimes takes the form of the removal of the scent sac, but more often resort is had to a method that is claimed to be just as efficacious and much more simple. The scent glands are located at the base of the tail. A contraction of the muscles enables the animal to eject the fluid. In extracting this scent sac the animal is put in a bag to keep him from biting and clawing and the gland is then removed. The wounds soon heal. The other method that the brothers use, and the one that is simpler than the complete [illegible] of the scent sacs, is the cutting [illegible] of the duct. When a piece of [illegible] off the wound heals and [illegible] so that the skunk is [illegible] for the rest of his life [illegible]

LEGAL NOTES

A very interesting decision has been handed down by the Supreme Court of the State of New York on a motion for a preliminary injunction in the case of Morris & Bendien vs. Alstedter

It appears that the plaintiffs in about 1910 originated and marketed artistic plaques known in the trade as woodenettes. The plaintiffs having done a large business both in the United States and Canada the defendants in June 1915 asked plaintiffs for a price on the woodenettes in large quantities. Defendants objected to the price gave no order for the goods and since September 1915, sold in Canada large quantities of goods so resembling the plaintiffs that the imitations it is claimed could have been made up only from photographic copies of plaintiffs goods. The defendants not denying receiving the proceeds of the Canadian sales contended the goods were not manufactured in the States but in Canada and that plaintiffs trade-mark was never registered in Canada. Citing numerous cases the court in granting the motion for an injunction pendente lite said

I am therefore of the opinion that in view of conduct of the defendant it not being denied that he attempted to purchase from these plaintiffs goods and upon their failure to agree upon the contract price that he in going into the Dominion of Canada and manufacturing articles similar to those which the plaintiffs had manufactured for years did so for the purpose of injuring these plaintiffs and that such acts undoubtedly come within the definition of unfair competition.

The District of Columbia Court of Appeal—In a series of fourteen decisions recently handed down in one day by the Court of Appeals of the District of Columbia the Court affirmed the decision of the Commissioner of Patents in thirteen out of the fourteen only reversing his decision in one case that of Storck v Reithheim the opinion being by Mr Justice Van Orsdel. In the other thirteen cases six were ex parte and seven were contested cases.

Non Registrability of Trademark Because Part of Corporate Name— In re United Drug Company the Court of Appeals of the District of Columbia held Stork as a trademark for rubber nipples not registrable because of the existence of a corporation named The Stork Company although the latter was not engaged in manufacturing nipples also the same court in The Mansfield Tire & Rubber Co v Fort Motor Company held the word Ford unregistrable because it is the principal characteristic word in the name of the Ford Motor Company holding at the same time that the name of a corporation is unregistrable to another regardless of the peculiar manner in which it may be written or printed

In re Herbst the Court of Appeals of the District of Columbia recently held that where in a trademark interference the Patent Office decided that the mark was unregistrable to an applicant and no appeal was taken to the court the question is *res adjudicata* and will not be reconsidered upon a new application merely because the applicant thinks a later decision by the court of appeals shows that the Patent Office was wrong in the first decision

On appeal from the District Court in the Western District of Michigan the Circuit Court of Appeals in Cadillac Motor Car Company against Austin held that the Austin patent 1091618 for change speed gearing for automobiles was not anticipated and discloses invention the device being the first practically operative two speed axle-drive gearing and also held claims 9 to 12 inclusive of such patent infringed.

Resolving Doubt in Favor of Applicant not Compulsory.—Commissioner Ewing in ex parte Poe, where the history of the application showed consistently dilatory prosecution, took occasion to say relative to resolving doubts in favor of the applicant, as follows: "

"The rule of reasonable doubt invoked by the attorney in a supplemental brief filed November 25, 1914, means that the existence and method of operation of an alleged anticipation must be established beyond a reasonable doubt. It does not mean that on the question of patentability over such an anticipation once established every reasonable doubt must be resolved in favor of the subsequent inventor. It is quite a common practice of the Office to resolve any doubt in favor of an applicant for patent, but there is no rule of law compelling this, and in many cases, a universal application of it is of questionable wisdom."

In reversing the decision of the Commissioner of Patents and holding that the application for cancellation of trademark should be dismissed in The Standard Brewing Company of Baltimore City v. Interboro Brewing Company, Inc., the Court of Appeals of the District of Columbia, by Mr. Justice Robb, says:

"The statute was intended as a shield to the innocent, rather than as a foil to the guilty. The appellee, on its own showing, has no right whatever to the use of this trade-mark. How, then can it be injured by its registration by the appellant? It is not concerned with the question whether the appellant's right to the mark is superior to that of the third party. If that party deems itself injured by the registration it may invoke the provisions of this statute, but certainly an interloper has no standing to invoke it."

A Decision as to Patentable Novelty.—In the decision in re Miehle Printing Press & Mfg. Co. v. Whitlock Printing Press Mfg. Co. Mr. Justice Lacombe, in the course of his decision, went on to say: "Patentable novelty is sometimes found in discovering what is the difficulty with an existing structure and what change in its elements will correct the difficulty, even though the means for introducing that element into the combination was old and their adaptation to the new purpose involves no patentable novelty."

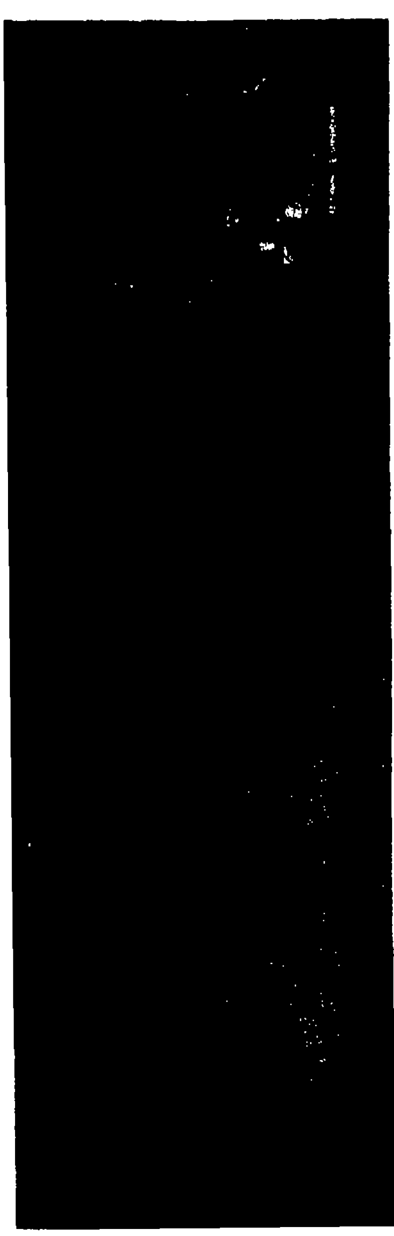
A Crown Seal Cork Decision.—Mr. Justice Dennison in Crown Cork & Seal Co., of Baltimore city v. Sterling Cork & Seal Co., goes on to say, "Having gone into the yielding plunger art and adopted and adapted the hydraulic cylinder yielding plunger into and for a bottle sealing machine and having thus bridged over what ever gap there was between bottle sealing machine and yielding plungers, and having thus incorporated the two arts together, he could not the next year adapt a mechanical trip yielding plunger to bottle sealing machine use and then get a valid patent covering any kind of a mechanical trip yielding plunger when used in a bottle sealing machine."

Disposal of License.—Judge Lacombe says, referring to a lessee of a patented machine: "We do not see why he may not give the lease to whomever he pleases * * * provided he * * * turns the machine over with the license label or other company marks affixed to the machine intact and unaltered so that his assignee may be fully advised of the conditions under which use of the machine is licensed." Victor Talking Machine Co. v. Strauss, et al.

Invention "On Sale."—In Wende v. Horine it was held that an offer to sell made to a prospective purchaser after the experimental stage has passed, the invention reduced to practice and the apparatus manufactured in its perfected form is a placing on sale within the statute.

Government Contractor Not Liable for use of Patented Inventions.—Owners of patents claiming infringement of their rights by contractors to the United States cannot interfere with execution and delivery by suing contractors and may obtain relief only from the Government itself, according to the recent decision of the Court of Appeals in the Marconi-Simon case.

The Marconi Company sought an injunction to prevent Emil J. Simon from producing twenty-five wireless sets ...



submarines of the United States Navy on a contract awarded him for delivery January 1st, 1916.

The plaintiff claimed infringement of the basic Marconi patent, while Simon maintained that any action should be brought against the Government itself for demanding the precise arrangement in its specifications. Walter H Pumphrey Esq, acting for the defendant and also for the Secretary of the Navy, stated that the court action was a menace to national safety in that it threatened to prevent delivery of apparatus necessary to the Navy and would force disclosure of valuable secrets of adjustment and operation discovered by Government experts A letter from the Secretary of the Navy was also submitted to the Court presenting the Government's desire that its work should not be interfered with

The case was decided by Judge Hough of the United States District Court, based on a previous ruling of the United States Supreme Court in the case of Crozier vs Krupp and was affirmed by the United States Court of Appeals to the effect that no cause for action of any kind arises against a contractor to the United States Government through the use of a patented invention in carrying out such contracts The theory basis is that the use of a patented invention by or for the Government is a use by the Government as a licensee (under an act of Congress of June 25th 1910), and the only recourse for the plaintiff due to such use is by action in the Court of Claims against the Government for royalties, as is distinctly provided for by the act.

Before the act of 1910 recovery from the Government was possible only when an actual license agreement (expresed or implied) existed between the Government and the owner of the patent and therefore in many cases recovery of royalties was imposible The act of 1910 makes the Government a licensee by law whenever it makes use of a patented invention and provides for full compensation in all cases

The decision of the Court of Appeals was handed down March 15th 1916

NEW BOOKS, ETC.

ELEVATORS A Practical Treatise on the Development and Design of Hand, Belt Steam Hydraulic and Electric Elevators By John H Jallings Chicago American Technical Society, 1915 8vo 224 pp , illustrated. Price, $1 50

The popular conception of the modern elevator generally leaves out of account the time and inventiveness that has led up to its present state of perfection It is in reality a microcosm of the history of mechanical invention evolved feature by feature from the unwieldy sling lift of fifty years ago to the admirable equipment of the Woolworth Building with its exacting demands of load speed and control The illustrations with which Mr Jallings work fairly teems, constitute a pictorial history of the development of the elevator Hand power belt power and worm and gear installments are followed by steam hydraulic and electrical equipments The author has not only witnessed this evolution he has himself materially contributed to it hence his very lucid exposition of fifty years of progress should find an honored niche in our as yet rather diminutive library of elevator construction and design

OXY ACETYLENE WELDING AND CUTTING Electric Forge and Thermit Welding By Harold P Manly Chief Engineer the American Bureau of Engineering Chicago Frederick J Drake & Co 1916 12mo , 215 pp , illustrated. $1 00

The author presents in a single handy volume not only oxy-acetylene welding processes, but also such auxiliary operations as annealing, tempering hardening heat treatment and the restoration of steel He deals too with the various metals, with the production and handling of the gases, and with the tools and accessories So good is his arrangement of material and so thoroughly has he pruned his work of all repetition and micro theory that every essential of present-day practice is adequately set forth and the welder and metal worker has only to refer to a detailed index to obtain immediate and accurate information upon any point

THE WRITERS' AND ARTISTS' YEAR-BOOK, 1916. A Directory for Writers, Artists and Photographers Edited by G E Mitton. London A. & C Black, Ltd 8vo., 180 pp. Price, 1s. net.

The American freelance who knows something of English requirements may often dispose advantageously of fiction and articles in the English market; to offset the lower

rate paid, material that is trite with us may be fresh and unusual to those living in a foreign environment. The directory also lists the leading periodicals of the United States and Canada. The requirements of each magazine or paper are carefully detailed, with the length stories and articles should run, the type most desired, and the rates usually paid The nature of the illustrations used is frequently indicated, thus making the work valuable to artists as well as to writers. There are numerous minor mistakes, but none that seriously impairs the reliability and usefulness of the work.

HOUSE WIRING By Thomas W Poppe New York The Norman W Henley Publishing Co, 1916. 16mo., 125 pp., fully illustrated Price, 50 cents.

"House Wiring" is a very business-like little treatise now in its second edition, in which the installment of electric light bells, and burglar alarms is described from the modern standpoint and with commendable simplicity Apprentices, helpers, and electricians will find in it the solutions of most wiring problems, and its practice is in strict conformity with the rulings of the National Board of Fire Underwriters.

THE VENTILATION HAND BOOK. By Charles L. Hubbard New York The Sheet Metal Publication Company, 1916 8vo, 250 pp., 187 engravings. Price, $2.

Using the question-and answer method, the author unfolds the principles and practice of warm-air heating and ventilation Simple rules are formulated for computing cubic contents and grate sizes, with many convenient tables dealing with such matters as the effects of gas jets and lamps upon ventilation, and fan diameters and horse-powers for fan drive installments. Everything is so plainly put that the reader has no excuse for misunderstanding, and it would be hard for the student to find a more serviceable introduction to the subject. The work is also well adapted for reference use, and the householder, who is about to install a furnace, and who has a laudable desire to understand just what his conditions call for and why, cannot go far astray if he will study the last chapter of the book.

INDUSTRIAL LEADERSHIP By H L Gantt New Haven Yale University Press 1916 12mo, 128 pp, 6 charts. Price $1 net.

The published addresses which make up this volume embody the principles of industrial leadership the training of workmen the proper bases for task work and its results, and the subject of production and sales The author who is well known in the field of scientific management believes that the coming industry will achieve success by teaching and leading its workers rather than by driving them and that democracy is to be vindicated in corporate as well as in national affairs Actual examples are cited of the improvement in task work by the establishment of the new methods, and these examples are illustrated by diagrams and charts The work carries both inspirational and practical elements and its suggestions bear the stamp of authority

LATHE DESIGN, CONSTRUCTION AND OPERATION With Practical Examples of Lathe Work By Oscar E Perrigo, M E New York The Norman W Henley Publishing Co., 1916. 8vo, 500 pp, 341 engravings Price, $2.50

The old, primitive lathe set up between two trees has developed into some of the most important and indispensable machinery known to the industrial world This most interesting and comprehensive volume traces its rise from the above-cited crude beginning through the foot power stage on to the development of the screw cutting or engine lathe of a half century ago This careful preparation furnishes an excellent groundwork for the study of the strictly modern forms up-to-date design is most thoroughly discussed in all its aspects and the essential differences of the various types are clearly disclosed This is followed by a chapter on installation, care, and operation—a new feature of the enlarged addition of the work Drilling and milling attachments are minutely described, together with a selection of the more difficult machining operations. Even the novice will here find such pointed exposition of modern practice as should directly contribute toward his rapid progress. The letterpress instruction is supplemented by lavish diagrams and engravings that put all important features and accessories before him in an impressive and unforgettable manner

HARPER'S HYDRAULIC TABLES. For the Flow of Water in Circular Pipes Under Pressure, Timber Flumes, Open Channels, and Egg Shaped Conduits. By Joseph H Harper New York: D Van Nostrand Company, 1916. 16mo., 192 pp. Price, $2 net.

The convenient arrangement of Mr Harper's material and the wide range of problems it covers should make this compilation eminently useful in actual field service Canal beds frequently change from solid rock to loose earth, sand or gravel, necessitating a prompt change in proportions and grade. This makes it necessary to incorporate into the working formula an element corresponding to the degree of roughness, and the author has paid particular attention to this condition in the tables he gives us. They will materially assist the field worker in making his computations.

Notes and Queries

Kindly keep your [illegible] of paper when corresponding [illegible] ters as patents, subscriptions, books, etc. This will greatly facilitate [illegible] tions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet [illegible] will be paid to unsigned queries. [illegible] to correspondents [illegible] and will be mailed on request.

(14077) L. A. W. asks: I have noticed very frequently in views of moving picture shows, where a wagon or automobile is moving, that many times the wheels are revolving backwards. A. The spokes of a wheel on a moving vehicle in a moving picture may appear to stand still, to move forwards or backwards. Which it shall be depends upon the speed of the wheel as compared with that of the shutter of the camera. As you probably know there is a revolving disk in the camera which cuts off the light many times a second. The film is at rest in the camera while the light falls upon it, and when the light is cut off, the film is moved into its position for the next exposure. If the spokes of the wheel turn just as fast as the exposures are made so that the spokes are in the same positions on the film in successive exposures, the wheel will appear to stand still on the screen. If it turns enough faster so that a spoke is in front of the position of the last exposure each time, the wheel will seem to turn forwards. If a spoke in the next exposure is behind the last position of the spoke which is in front of it as the wheel turns, the wheel seems to turn backwards.

(14078) A. G asks Please inform me as to where thermopiles can be bought. I am interested in thermopiles that would yield a current about equal to that of a Bunsen cell or Grove cell, at least as near as obtainable A No thermopiles for commercial purposes are to be had so far as we know The thermopile can be made to give the voltage of a Bunsen cell with a sufficient number of couples, but we have never seen one which could give as many amperes as the Bunsen cell An effort was made some years ago to make one which would charge a battery for ignition purposes on an automobile, but it was not a success. We have one in our laboratory, kept as a curiosity now

(14079) F F H asks 1 What are the reasons that liquid air has not been put to the practical uses suggested for it when it was first made? Is there any use made of it at present? 2 What is the cause of the temperature dropping 2 to 6 deg Fahr just at sunrise on clear cold mornings. 3. What is the nature and cause of "ball" lightning. A 1. Liquid air is poorly adapted to the uses which were suggested for it when it was first made in large quantities—that is, for refrigeration and for power Its latent heat of evaporation is small and its specific heat is also small. It cannot compete with ammonia for refrigeration. It cannot be kept in a closed vessel, but must always have a vent to the air. For explosives many better materials are available. It is used to some extent to secure the oxygen of the air by first liquefying the air and then boiling off the nitrogen, which boils at a lower temperature than the oxygen. 2. It is coldest just about sunrise every morning. The ground radiates heat through the night and until the sun begins to warm the ground again We were not aware that there was a sudden drop of temperature just at sunrise. 3. Ball lightning is not well understood.

(14080) W R. H asks: I have a lady friend, who has the peculiar—to me—faculty of seeing and of stating the colors of names and sounds. There is no doubt about her ability to do this, and to do it accurately I have tested her For instance, I have written a list of names—she has stated the color of each name as soon as I called it. I have set her answer down and filed the list—and several months after I have called the list to her and she would state the colors exactly as she did at first. Is there a scientific basis for this? A. You will find several articles upon Color Music in the Sci. Am within the last year, in Vol. 112, No. 15, and Vol. 113, Nos. 4 and 9, which we can send to you for ten cents each. We confess the whole thing seems a fancy to us, but if it is real to those who see it that way, why should we object. There can be no doubt of the reality of the association of sounds to persons and corresponding colors. What association has produced the connection we cannot say, nor whether different persons would or ought to have the same scale of association as they should have if there is other than an arbitrary or individual basis for the association.

(14081) G. M. asks: By what methods can china, earthenware, plaster of paris, and articles of like nature be given a coat of metal by electric deposition; in other words, electroplated? [illegible]

is covered with plumbago, which furnishes a conducting coating for the deposit of the metal from the electroplating bath Full particulars are given in "Watt's Electroplating which we send for $4.50.

(14082) J L. asks: I fear this following question has often been asked you but I would like to know if a bullet from a rifle fired perpendicular into the air has the same force when it comes back to earth as it does when it leaves the muzzle of the rifle? Will it show the same penetration? It is generally taught in physics that it falls with equal velocity as it ascends Is there a certain definite relation between velocity and force? A. A bullet fired vertically into the air does not have the same force when it strikes the ground upon its descent as when it left the muzzle of the gun upon its ascent. The resistance of the air to rapidly moving bodies is very great. We have recently published diagrams of the paths of projectiles from high powered guns, showing the difference between the theoretical and actual trajectories You will find the article in the Sci. Am. Vol 112, No 21 price ten cents. The resistance of the air reduces the velocity of the ascending ball so that it does not rise to the height indicated by its muzzle velocity It therefore starts to fall from a lower than the theoretical point, and the air retards its fall so that it does not acquire its full velocity of fall from the point from which it actually began to fall For both reasons it does not make so much penetration on its return The teaching of the text books of physics that bodies fall in the reverse order of their ascent and strike with the velocity with which they started is based upon the omission of any other forces than that of gravity It is usually so stated In one text now before us is the statement The resistance of the air is neglected in this discussion of projection upward Other things being the same a given force always produces the same velocity

(14083) G J asks Will you kindly answer through your Notes and Queries column the following If a weighing scales, such as used by druggists were inclosed in a glass case in two compartments with equal weights at each end and the air extracted fro one compartment would it make the other side heavier and cause it to tilt? A. If the two pans of a balance were enclosed in separate compartments and accurately balanced and the air were then exhausted from one compartment, the pan in the compartment from which the air had been exhausted would become the heavier and would tilt down The air buoys up a body in it as really as water does and so when the buoyancy of the air is removed that body seems to become heavier In accurate weighing the buoyancy of the air is allowed for and the weight of a body is taken to be its weight in a vacuum not its apparent weight in the air The difference is quite considerable for light substances.

(14084) H M asks 1 Has there been any decided change in the climate of this region in the last hundred years? I notice that most old people say that the winters are not nearly so cold now as they were when they were young 2 Please explain the formation of ice spears that come up out of loose ground. I notice the phenomenon often in this latitude. Do we have frost when the thermometer registers higher than 32 deg ? I have heard it stated that we did. A 1 Weather data as secured by the U S Weather Bureau do not bear out the claim so often made that the climate is changing The differences are about the same as they have always been. Warm winters are succeeded by cold ones and for several years it may seem that the winters are warmer but the years of cold winters follow and when the averages are struck it is found that hot and cold wet and dry seasons follow along as they used to do when we were boys. It is very difficult to tell how cold it was when we were young unless there is a record of a thermometer to be referred to. One s recollection is very unreliable in such matters. 2 The ice spicules which are seen in cold weather in loose soil grow by chilling the moisture of the air and freezing it upon the sides and top of the ice form. Frost cannot occur unless the temperature at the place where the frost appears is as low as 32 deg the freezing point of water A few feet or inches even away from where the frost appears it may be warmer than 32 deg The green leaves are colder than the air near them and they may be frost bitten while close to them frost may not be seen.

(14085) B. F asks 1 What direction has the atmosphere above the equatorial belt of calms by reason of the earth s rotation, east to west or west to east? If these are deflected to the west as are those on the earth s surface, how can they be turned to form the prevailing westerlies when they return to the earth s surface in the horse latitudes? 2 What is the direction of the circumpolar whirl? Is there a difference in direction at the earth s surface and in the winds high above the earth s surface at the poles? 3. If a Crookes radiometer reacts to waves of radiant energy which will pass through an opaque solution, which waves are not of the proper length to affect sight why will it not react to waves radiating from a stove, which waves do not affect the sense of sight? 4. Is there no radiant energy in diffused sunlight, since the radiometer does not react unless in direct sunlight? 5. Can the radiant energy be proven less in reflected direct sunlight than in direct sunlight? A. 1. The current of air flowing to the north above the

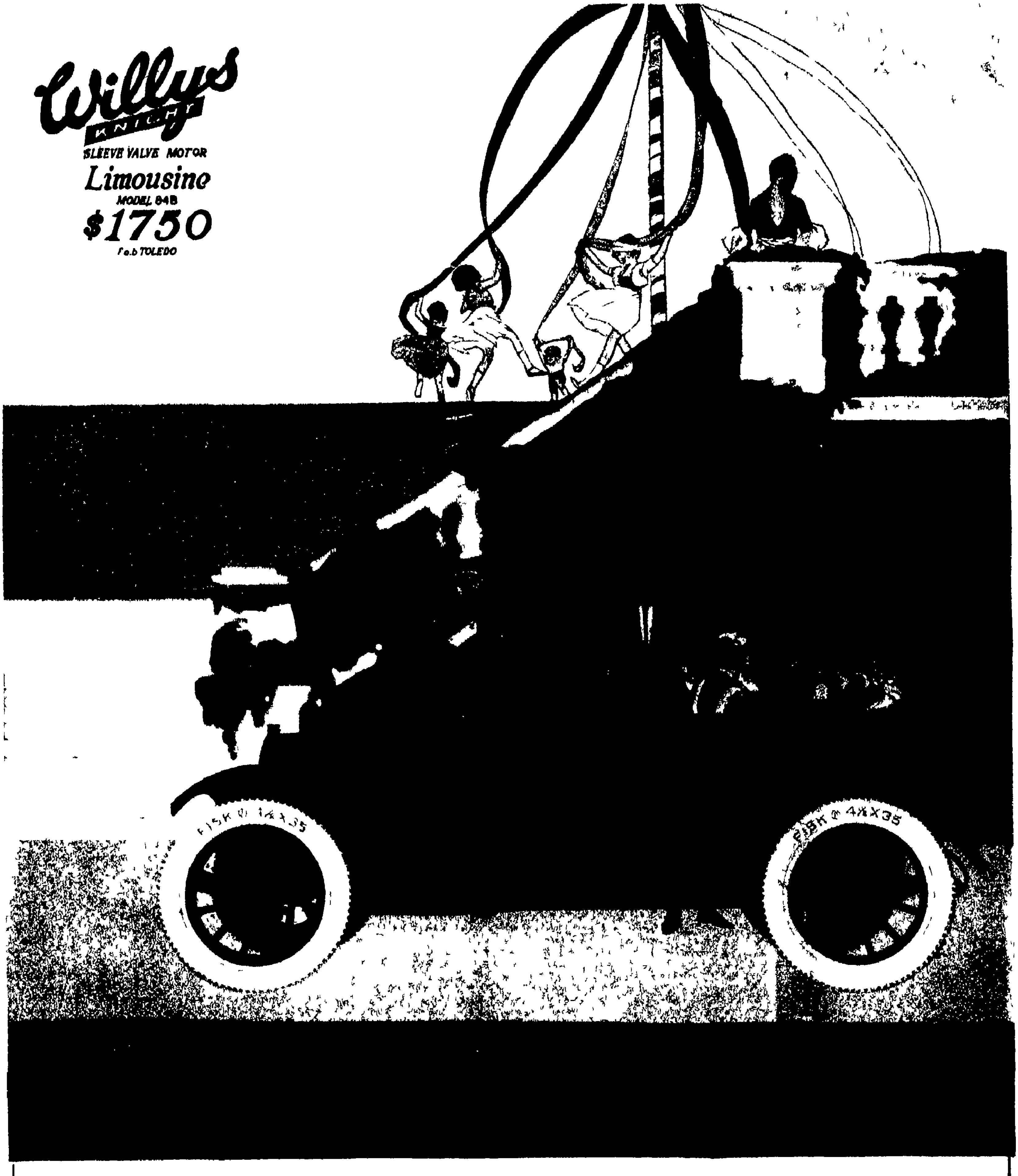
northeast trades in the Torrid Zone is deflected toward the east by the rotation of the earth. This is stated as a law in meteorology: "If a free moving particle (such as air) is moving along near the earth's surface, there is a force arising from the diurnal rotation of the earth which deflects it to the right of its course in the northern hemisphere, and to the left in the southern hemisphere" Therefore, wind moving from north to south in the northern hemisphere is deflected towards the west forming the northeast trades, and the winds moving from south to north are deflected towards the east forming the southwest winds. All these matters of the winds are well-discussed in Waldo s Elementary Meteorology, which we can supply for $1 50 net, postpaid $1 65 2 The winds around the north pole are southwest for the reason stated above They are moving from a place where the earth is rotating faster to one where it is rotating slower, and retain to a degree the eastward velocity of rotation of the place from which they have come They will move eastward faster than the surface of the earth where they are and have an eastward motion thus becoming southwest winds 3 A radiometer will react or rotate by the heat from a black stove or a black iron ball, which can be safely touched with the finger We have a radiometer which will turn from the heat radiated from water above 50 deg C or 122 deg Fahr in a dark room. At this temperature the radiometer ceased to rotate 4 There is a great deal of radiation from the sky outside of direct sun light To-day has been a dark snowy day, yet the radiometers have been turning in the windows all day slowly to be sure, but moving all the time 5 If sunlight is reflected several times it becomes enfeebled to a high degree. Each mirror absorbs some of the radiant energy and it can then be seen that the speed of the radiometer is reduced It would seem that your radiometer is not very sensitive if it will not turn by the heat of a stove, or in diffused sunlight as it comes from the sky in a cloudy day

(14086) H C M writes Permit me to call attention to an apparent error in the answer No 14050 page 209 of the issue of Feb 19th, 1916 Referring to the expansion of gases it is stated that the rate is $\frac{1}{459}$ of the volume at freezing for each deg Fahr Gay Lussac s Law states that Under constant pressure the volume of a gas varies directly with its Absolute Temperature and the rate of expansion is $\frac{1}{273}$ per deg C of its volume at freezing This then calls for a rate of $5/9 \times \frac{1}{273} = \frac{1}{491.4}$ per deg Fahr—a fact also evident from the fact that on the Absolute Fahrenheit scale the freezing temperature is 459 4 + 32 or 491 4 deg instead of the 459 deg which your answer implies A We thank you for calling attention to the typographical error in giving the number of degrees Fahrenheit from the freezing point down to Absolute Zero as 459, in place of 491 which is the correct number Absolute Zero is 459 deg below Fahrenheit Zero not below the Fahrenheit freezing point of water which was intended in the answer

(14087) H R P asks Will you please tell me how the correct time is taken at Washington B claims it is taken from the sun A claims the sun is not correct, and the time is figured from the stars Which is right? A. The time for any place can be determined from observations either of the stars or the sun From the observations which give the sidereal time the solar and Standard time can be calculated We use Eastern Standard Time in New York This is five hours earlier than Greenwich Time It is not solar time It is the mean solar time of the 75th meridian west of Greenwich

(14088) R R. asks A tank 6-6 feet square, with a 1½-inch pipe attached to bottom of the tank 20 feet long with a gauge at the bottom of pipe. Then take a pipe, 26 feet long 1½ inches in diameter, and a gauge at bottom, will there be any difference in the pressure and how much? Both tank and pipes filled with water A The pressure at the gauge is the same in both the cases which you show in your sketch The size and shape of the vessel have no effect upon the rate of pressure at the bottom. The rate of pressure is determined by the head of water and by no other factor This pressure for a head of 26 feet is 11 7 pounds per square inch

(14089) C S B asks In an article that appeared recently in the SCIENTIFIC AMERICAN, ammonium carbonate was said to be a test for alum in bread The writer said that if bread with alum in it were moistened with a solution of ammonium carbonate, the bread would turn black. What is the chemical reaction? And why will not ammonium carbonate turn alum solution black? A There is no chemical reaction between alum and ammonium carbonate which can produce a black substance. There is some mistake in reference to this as a test for alum in bread. The tests for alum are not easy of application without experience in chemical manipulation. The easiest, perhaps, is to dry the bread and burn to ashes. Digest the ashes with a small quantity of water, then acidify this solution with hydrochloric acid, and add a few drops of barium chloride solution. If alum is present a white precipitate appears.



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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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Some of the difficulties that the engineers had to contend with at Mile 9

Working on a bend in the road at Mile 10

Building the World's Highest Highway

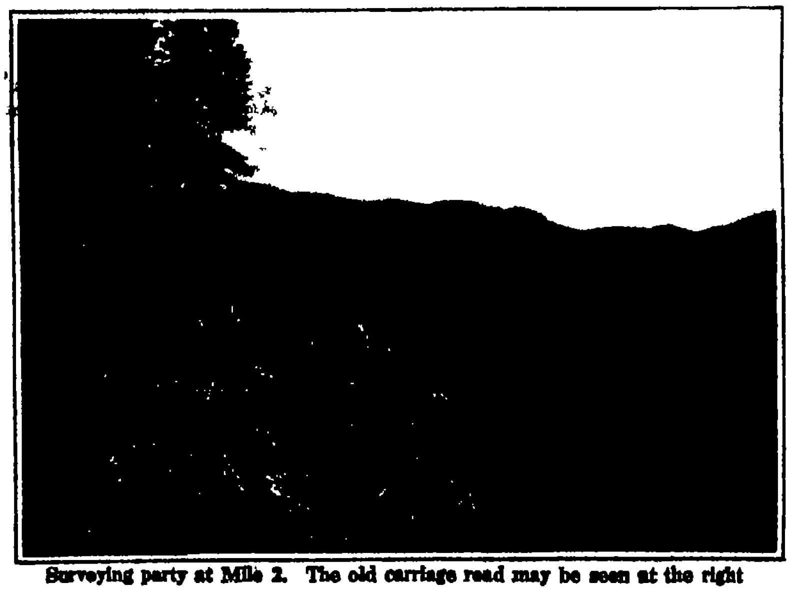
By N. L. Drew

FIVE score and ten years ago Lieut. Zebulon Montgomery Pike discovered the famous mountain that now bears his name. After making several attempts to reach the summit on foot he was forced to give up, predicting in his diary that no human being would ever be able to scale its rocky heights. For thirteen years thereafter the great white mountain hurled defiance at many other sturdy pioneers who made similar attempts to reach the top. In August of 1916 the speed kings of the motor world are going to race up the rock walled sides of this giant sentinel of the Rockies over a double track motor highway that has been pronounced by eminent engineers to be one of the greatest road building achievements of the age.

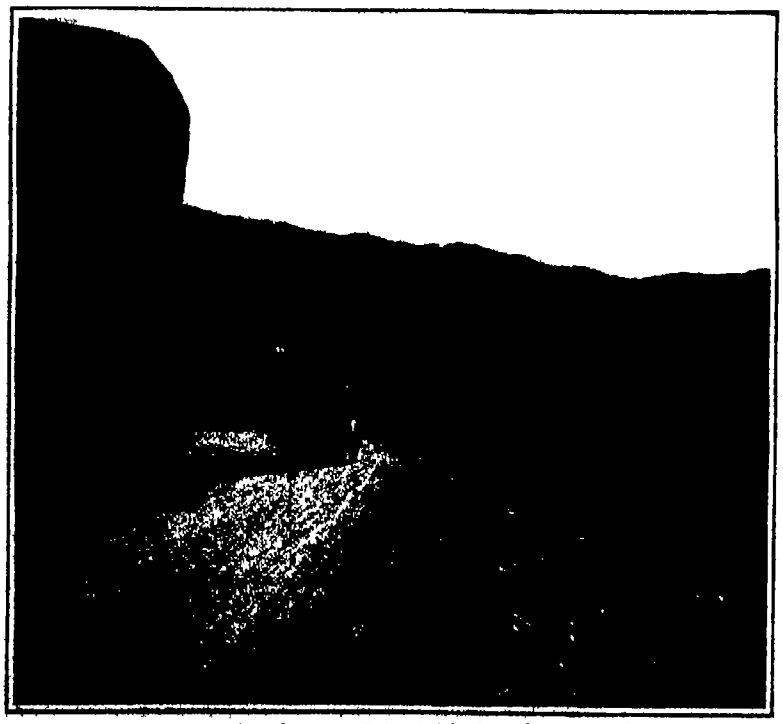
To scale this mighty mountain with a 20-foot highway, 18 miles long and reaching into the clouds 14,109 feet above the sea, required engineering skill, push, dynamite, men and money. Government engineers had predicted that it could not be accomplished in two years, but the builder did it in five months between the snows of 1915.

Early in January of last year, Eugene A. Sunderlin, of Colorado Springs, secured pledges of financial support, and in May he began construction of the world's highest highway to the summit of Pike's Peak. Large construction camps were established every second mile. Expert rock workers were brought in from the mining districts; and with fifteen 20-ton cars of dynamite, the road was blasted through fields of massive boulders and up the precipitous granite walls of the Peak. From sun to sun for five months a ceaseless roar of tons of explosives was re-echoed by the grim old mountain to the valleys below. Great boulders were lifted from their anchorage and thrown down the mountain sides 2,000 feet below. Giant pines were lifted up by the roots with powder to make way for the road.

Specifications called for a minimum width of 20 feet, on tangents with curves from [illegible] to [illegible] feet as required and super-elevation, so that two machines might pass at any point with safety. The grade has



Surveying party at Mile 2. The old carriage road may be seen at the right



One of the broad turns of the finished roadway at Mile 2

been held to an average of 6 per cent, with a maximum of 10 per cent, which will permit any car to negotiate the summit with ease. Masonry parapets 2½ feet high and 18 inches wide, for guard rail walls on curves which average 40 degrees are provided where needed. Gravity or windmill tank and hose water stations are spaced every third mile, together with supply and repair stations at convenient points. Telephone stations afford easy communication with the outside world. The five bridges are of reinforced concrete of the ballasted deck type and are located on tangents only and may be seen 300 feet away. The surface of the road is all of a disintegrated granite formation which has been packed down by the use of wide-tired trucks to a hard and smooth surface.

Starting at Cascade in Ute Pass 12 miles west of Colorado Springs, the first two miles is one large swing in order to gain elevation and enter Cascade Cañon, half a mile above the starting point. Miles 3, 4 and 5 follow the water grade of Cascade Creek to the divide between this and Crystal Creek watershed, and then cross the latter stream in Mile 6 by a slight adverse grade. The next five miles is a climb to the base of the main range of the Peak at Glen Cove, a beautiful natural amphitheater near timberline in Mile 11. Leaving Glen Cove the ascent to the crest of the Rampart Range in Mile 14 is made by a series of ten immense swings of the road forming two "W's," two swings preceding and two following. In these three miles over 60,000 cubic yards of solid rock were excavated, but it was practically the only route over which the top of the range could be gained, for on all other routes proposed there is a sloping country with angles of repose which did not afford safe or permanent road bed sections. Miles 15 to 17 follow along the backbone of the main range, the last mile having three swings by which the summit is gained. Here are several acres of comparatively level space for parking purposes.

A trip over this magnificent highway offers much of scenic interest to the motorist and may be made easily in two hours in each direction.

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The object of this journal is to record accurately and lucidly the latest scientific mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Arms and the Man

IN its broadest generalization, it may be said that an army is made up of personnel and supplies. Each is fully as important as the other. Arms without the man would be only less impotent than the man without arms. The immortal Bryan's army of 1,000,000 men, raised between sun and sun, would be merely a mob 1,000,000 strong.

In its legislative work for a larger army Congress seems to be overlooking the equally important matter of providing (as it should do simultaneously) the corresponding supplies of guns, ammunition, transport and general equipment.

The Russian disaster of last year showed the helplessness of a large army insufficiently equipped, when confronted by a force well supplied. An examination of the hearings of our staff officers before the Congressional committees this year proves that we are far behind Russia in supplies of all kinds.

We have none of the large field pieces which have proven so valuable in the European War. Our largest field piece is the 6-inch, which the English artillerists call "The Baby." The total of our field guns is 900 of all calibers, sufficient for an army of 250,000 without any reserve. Of ammunition there is less than 050 rounds per gun. It is reported that, in certain actions, the French artillery has fired 1,000 rounds per piece. Our arsenals are capable of producing about 500 field guns and about 500,000 rounds of ammunition per year, the latter General Crosier estimates as being about one fiftieth the amount used by one of the countries now at war.

In rifles the situation is equally serious. We have 700,000 service rifles and about 400,000 of the old Krags. The maximum output of our arsenals is 437,000 rifles per year, working day and night. Of ammunition we have a reserve of 800 rounds per rifle, and our plants, also working three shifts, could turn out something over 300 rounds per rifle per year. When it is considered that each soldier carries 120 rounds for one day's engagement the inadequacy is easily appreciated.

The Chief of Ordnance reports that we have 1,077 machine guns completed and under manufacture, "not all, by any means, of the latest model." For the present army alone 2,225 are needed, and this is based, not on lessons learned from the great war, but on theory prior thereto.

Of personal equipments of the soldier we have on hand only 450,000.

Our coast forts are armed largely with obsolescent guns and mortars, excellent when designed and mounted but now far behind naval ordnance in range and power. Some of the carriages can be remodeled to give the guns greater range, but new and more powerful weapons are a vital need in all of the more important harbors if an enemy is to be held beyond bombarding range of the cities our forts were constructed to protect. For the guns we have, the ammunition is notoriously insufficient—a half hour's continuous fighting would see the end of it in most batteries. We hear also of shortage in search lights, in range-finding apparatus, in submarine mine material and in air craft. The Chief of Coast Artillery dwells upon these in his annual report.

Consideration of the foregoing should indicate the fallacy of depending upon government-owned plants for the supply of munitions of war. In all these years of peace they have been able to supply only our small army and accumulate a reserve sufficient for a quarter of a million men for a war lasting from a few days to a month according to the energy with which we were attacked. The European War has demonstrated that all resources of a nation must be mobilized for modern war. Numerous private ammunition plants have been started in this country. It seems the part of wisdom to conserve this resource. The owners cannot be expected to continue operations if the demand ceases. Our Government should not permit the demand to cease until we have accumulated a sufficient reserve, and then the companies should be paid a reasonable amount annually to maintain the machinery in condition and to keep a nucleus of trained personnel.

And we should not await the preparation of designs for large-caliber field guns. Several of the warring countries have guns of proven effectiveness. Why not make weapons of the same types until something better is found? We should then, at least, start even, instead of many years behind.

We have felt secure in the matter of transport on account of our great motor car factories. But in spite of the Quartermaster General's testimony of our "organized motor truck companies" (tentative), a week elapsed before General Pershing could start his pursuit of Villa with 4,000 men. Neither trucks nor chauffeurs were available. Villa, instead of being overtaken in a day, had a week's start, involving us in a prolonged campaign of doubtful result, and in a diplomatic situation which will require the nicest handling if worse is to be avoided. So much for paper organizations. In reality the Army is short even of the obsolete wagon transportation, and the Militia is generally without draft animals of any kind.

General Aleshire states that we have reserves of clothing for 150,000 men, and that in 90 days we should be able to turn out uniforms for 600,000 more. It is true we have not the dye for these new uniforms, any more than we have the nitrates to continue the manufacture of powder for more than a month, but these things do not seem to cause any worry to those responsible for the conditions.

Further examples seem unnecessary. *The situation may be summed up by the statement that in practically every essential we are short of proper reserves for our existing military forces, to say nothing of those we propose to create.*

Our legislators shrink from the thought of a bond issue. But how otherwise are we to remedy promptly the results of our niggardly past policy, in which each Congress under guise of economy, has declined to appropriate sums sufficient for our needs? The current revenues will not meet the issue. Our modest field artillery project would cost $280,000,000 for guns alone, the half hour's allowance of coast artillery ammunition has cost over $7,000,000. To modernize our coast forts and emplace guns of sufficient power to repel modern warships will cost not less than $100,000,000. If the proper equipment of our new army, with the National Guard second line, can be done with less than a billion, it will be surprising.

It is an issue we cannot dodge. If even the poorer nations of Europe are willing to meet the needs for defense (or aggression) are we with all our wealth, estimated by the Bureau of Statistics to be $225,000,000,000, with all we have to protect, to hang back? If we are, let us at least do it with our eyes open. Let us know that we are maintaining an expensive military force without giving it the equipment which alone can make it an effective protection to the nation.

Zeppelins as Battleship Destroyers

EVER since the beginning of the European conflict, much has been said regarding the use of Zeppelins in naval engagements. The recent dispatch from a correspondent of one of the American press associations, to the effect that the Teutons have been experimenting over Lake Constance with a highly destructive form of bomb suspended on a two-mile cable again directs our attention momentarily to these mighty airships.

It is safe to assume that Count Zeppelin, in designing his airships, has not only had in mind their employment in land operations, but also in naval engagements, furthermore we are tempted to believe that the aged inventor has for years cherished the hope of some day seeing his air cruisers, equipped with terrible and heretofore unknown engines of warfare, capable of swinging the tide of naval supremacy from Great Britain to the side of Germany. This much we know: experiments with bombs and aerial torpedoes have been carried out at the Zeppelin plants with a persistency of effort that is characteristically Teuton.

During the naval engagement in the Bight of Heligoland the British cruisers found themselves in combat not only with enemy vessels and submarines, but also with German seaplanes and Zeppelins. It will be recalled that during the engagement the air cruisers dropped a number of bombs intended for the destruction of the warships, but owing to the difficulty of aiming and the skillful maneuvering of the British vessels, these failed to reach their mark. This engagement, then proved more or less conclusively that aerial bombs may be readily evaded by vessels in the hands of skilled crews, and that the possibilities of the bomb droppers scoring hits on their targets below are no greater—if as great—than those of the anti-aircraft gunners hitting their aerial antagonists.

It would be premature to state definitely that the Teutons have been discouraged in the use of aerial bombs, for legitimate military and naval attack. They are not a people to be readily discouraged in the development of an idea. Better be it said that they have latterly turned their efforts in other directions in the endeavor to obtain more certain results, among these being contact mines and bombs lowered down from the Zeppelins by means of fine steel wires.

The present rumor conveys the information that the Zeppelins of the most recent type are equipped with bombs filled with powerful explosive, suspended by a wire cable a mile or two below the airship. It is reported that the bombs are exploded electrically by the Zeppelin crew the moment they come in contact with an enemy vessel. At a first reading this new engine of warfare, if it were practicable, would be truly formidable, but let us analyze the problem confronting the use of such bombs. Let us assume that the explosive rests on the surface of the water, and is dragged along by the cable, until it comes in contact with enemy vessels. Anyone who has had experience in towing will realize how impossible it would be to direct, with any accuracy, the movements of a floating body drawn over the surface by a towline some 2 miles in length. A change of course by the Zeppelin would not be communicated to the floating bombs for several seconds, and at first only to a very limited degree. The process would be so slow that a slight change of helm would put the vessel attacked out of the danger zone. Meanwhile he would turn his rapid fire battery upon the bombs. Indeed, torpedo boat destroyers and smaller craft might well be employed to circle about the major units of a fleet, just as they do in present practice as a precaution against torpedoes. There is a possibility that the bombs are intended to be lowered directly over the targets, but this brings up the old question of marksmanship and of maneuvering by the enemy vessel, so that little is gained over the use of ordinary bombs.

It is safe to brand this latest rumor as another of the almost countless ones that have preceded it, most of which are circulated more for their moral effect on the enemy's and neutral world's citizenry than as advance information for the benefit of the fighting men who oppose the Teutons and their allies.

Government Manufacturing

THE present hearing in the Senate Committee of Naval Affairs on the question of the establishment of a government armor making plant is bringing up all the elements of the general question of the extent to which the Federal Government should go in the manufacture of materials required for its own consumption. The materials used by the Government cover the entire field of industry and consist in part of special products for which national governments are almost the only market, such as armor, artillery, warships, munitions, etc., and in part of materials of general use.

At the present time the Government is engaged in considerable manufacturing activity in both categories, and some of its enterprises have produced very beneficial results, such as the reduction in the cost and the increase of the supply of powder, the reduction in the time required to build battleships, the increase in the supply and capacity to supply torpedoes and mines.

The amount of manufacturing to be undertaken by the Government should be determined by business principles and military necessity. The present war has shown the necessity of supplementing the country's capacity of production of a given article of restricted use in peace times, to make sure of the provision of adequate amounts during the unusual demands of war fare. It may be necessary to stimulate competition, where, because of restricted demand, insufficient interest is taken by private enterprise in producing the article on time and with economy. Furthermore, government manufacture may be required to prevent excessive prices or to determine proper prices where they are believed to be excessive.

Most of these considerations, of course, do not obtain for articles in general use, where quantities are sufficient and prices established by a large volume of trade. Hence, in order to proceed intelligently, the unsatisfactory condition that exists should be carefully defined in order that the manufacturing undertaken by the Government should correct, regulate and stimulate it, without providing for the entire capacity required.

The first step should be to take census (as is now being done by the Naval Consulting Board) and then develop the munition-making capacity of this country to take care of the maximum probable expenditure during war, the Government to supply manufacturing capacity which cannot otherwise be obtained.

The ability of private enterprise to expand to any emergency when called upon, if it has a certainty of sufficient business, is at the present time. Much can be obtained by appealing to the patriotism and business sense of the industries affected, and further extension of Government manufacturing should await the result of that appeal.

Electricity

An Electrical Apartment House for New York.—It is learned that plans have been drawn up for a model sixteen-story apartment house soon to be erected in New York City, in which electricity will be used in every possible way, including cooking and refrigeration.

Tungsten Consumed in Lamp Manufacture.—It is gathered from unquestionable authority that the total amount of standard tungsten ore used in the manufacture of incandescent lamps in the United States in 1915 was in the neighborhood of 4½ tons.

The Stealing of Rail Bonds.—Among the problems of a Massachusetts street railway company is that of preventing its rail bonds from being stolen. Recently about 170 copper rail bonds were removed from its tracks with a chisel and sledge hammer, representing a loss to the company of some $300 for material alone, not counting the inconvenience caused to traffic and the cost of labor in re-bonding the rails.

Metal-Vapor Lamp Invented by Nernst.—Prof Nernst, inventor of the Nernst lamp, has patented a new vapor lamp in which the vapor from zinc chloride or zinc bromide is used, according to a statement in *Elektrizität* It is said that the color of the light is white and that the efficiency is in the neighborhood of that of the mercury vapor lamp. The exclusion of air and other foreign gases is essential to the successful operation of the lamp

Electric Radiators for Electric Vehicles.—A domestic manufacturer has introduced an electric heater intended for use in electric vehicles. In general appearance the heater resembles a steam radiator, it is made of cast iron sections 15 inches high and has 3 square feet of radiating surface An insulating liquid is placed in the coils of the heater, while the heating element is mounted in the bottom The latter operates on 80 volts and requires a current of about 3.9 amperes for furnishing a temperature of 190 deg

Load Dispatching Record on Phonograph Cylinder.—A Pennsylvania power company has installed phonograph dictating machines at the main power plant and at a substation, which serve to make a wax cylinder record of all telephone messages regarding load dispatching All messages which are received are repeated to the sender, so that corrections if necessary can be immediately made in the orders. The two phonographs act as a check on each other and avoid all disputes.

Lineman's Shoe Withstands 20,000 Volts.—An American manufacturer has recently placed on the market a line of shoes for electrical workers, which are made to withstand potentials up to 20,000 volts without harm to the wearer The shoes contain no cement and have no seams, but are vulcanized into a solid piece under high pressure in aluminum moulds. A novel feature of the shoes is that the soles are white, and under the white surface is a layer of red rubber When the sole has worn down to a point where the red is exposed it is a sign to the wearer that a new half sole should be immediately cemented in place.

Gas-Filled Lamps in Photographic Work.—The convenience and comparatively low cost of gas-filled electric lamps has resulted in their wide adoption in photographic work. Usually the lamps are operated at a 10 per cent increase in voltage in order to augment materially the actinic value of the light emitted by them Obviously, the life of the lamps is reduced by this practice, but since the lamps are only used for very short intervals at a time, the reduction in life is negligible It is stated that the lamps, operating at a 10 per cent increase in voltage, have a life of about 800 hours instead of 1,000.

Power Company Substitutes Copper for Aluminum.—Owing to the abnormal price of aluminum at present, a California power company recently took down cables of that metal serving in some 22 miles of transmission lines and replaced them with copper ones of greater carrying capacity The proceeds from the aluminum wire thus released from service are said to have been sufficient not only to pay for the copper cables but also for the labor involved in making the change It is reported that the company is continuing in this work and that several other power interests are doing likewise.

Electric Heat for Shoe Machines.—In the shoe factories of Lynn and Brockton, Mass., there is being witnessed the gradual introduction of welting machines, shoe stitchers and bobbin winders equipped with electrically heated wax pots Heretofore, steam-operated machines were used. It is interesting by way of contrast to learn that in some shops it requires an hour and a half to bring the wax to the proper point for application, while electrically-heated wax pots bring their contents to the desired point in only 20 minutes. This difference in time results in a considerable saving when electricity is used; the current is reported to cost but 20 per cent as much as gas to do the same work.

Science

A Notable Gift to the University of California is the library of about 6,000 volumes representing France's contribution to civilization, which formed part of the French government exhibit at the Panama Pacific Exposition

Varieties of Maize Grown by the Indians.—The Bureau of Plant Industry has been investigating the maize grown by various tribes of American Indians, with a view to obtaining breeding material for the improvement of commercial strains. Thirty varieties have been studied, and it appears that they include many adaptations, the value of which had been previously overlooked The Assiniboine and Mandan tribes have both sweet and field varieties that are earlier than the commercial varieties. Others, particularly the Omaha and Otoe tribes, have varieties showing a remarkable development of slender, leafy stalks suitable for forage

The Tuatara, or tuatera, is an almost extinct lizard like reptile (*Sphenodon punctatum*), now found only on certain rocky islets in the Bay of Plenty, northern New Zealand It is of great scientific interest for the reason that it is the only surviving representative of the order of Prosauria, or primitive reptiles, and is therefore a sort of 'living fossil It was formerly hunted for food, but is now protected by law in New Zealand. The *American Museum Journal*, in which the foregoing facts are recorded, stated that of five living specimens of this reptile which formed part of the New Zealand exhibit at the Panama Pacific Exposition, two have been presented to the American Museum of Natural History No living specimens had been seen in this country prior to the exposition

Some Details of Otto Sverdrup's Expedition along the Siberian coast, which returned to Archangel last September are published in the *Geographische Zeitschrift* The expedition wintered on the east side of Cape Wild, whence a sledging party was sent to join the Vilkitskii expedition, which was frozen in on the east side of the Taimyr peninsula, about 200 miles distant As Vilkitskii's party was running short of food, thirty of his men marched across the peninsula and joined Sverdrup's ship A thorough exploration was made of Lonely Island, discovered by Johannsen in 1878 and never since revisited It was found to contain rich coal deposits Many corrections were made in the map of the coast between Cape Chelyuskin and the Yenisei River

Topographic Mapping and National Defense.—The *Geographical Review*, in commenting on the work of the U S. Geological Survey, makes the interesting point that the relatively slow progress of topographic surveying and mapping in this country is serious from a military point of view "Maps covering 40,000 square miles are less showy than a battleship, but they may be of much greater importance in time of war" Only 40 2 per cent of the area of the country has been covered by topographic surveys up to the end of the last fiscal year The area mapped during the year was 20,508 square miles. Mapping has been completed for Connecticut, the District of Columbia, Maryland, Massachusetts, New Jersey, Rhode Island and Washington New York State is 89 per cent complete and Ohio 97 per cent.

A Fog-Signal Sound Deflector.—The nerve-racking noise of a fog siren is a problem that needs to be dealt with whenever one of these valuable devices is located near human habitations The Bureau of Lighthouses has recently installed a sound deflector at the Buffalo light station, to diminish the spreading of the sound from the fog signal back over the city of Buffalo It consists of a saucer-shaped shield of steel plating 14 feet in diameter In order to reduce vibration, it is lined on the face toward the lake with asbestos board, and, to further deaden the sound, a space of 4 inches between the asbestos lining and the steel is filled with mineral wool The steel surface was suitably treated to minimize or prevent corrosion from the sulphur impurities in the wool. The deflector is reported to be effective in reducing the sound of the siren in the city

Fog Statistics of the Lighthouse Bureau.—The *Lighthouse Service Bulletin* publishes a compilation of the number of hours of fog or thick weather observed per year at 508 fog signal stations during the period 1885 to 1915 As such stations are maintained in all coastal regions of the country, including the Great Lakes which are subject to fog, their records are a valuable indication of the extent of this danger to navigation The highest annual average is 1,691 hours a year at Petit Manan, Me, while the highest record for an individual year and place is 2,734 hours in 1907 at Seguin, Me. or about 30 per cent of the entire year It is interesting to learn that Calumet Harbor, near Chicago, had 2,269 hours of fog in 1913 This and other lake stations are affected somewhat by smoke. On the Pacific coast the highest annual average is 1,337 hours at Point Reyes, but in the year 1915 there were 2,145 hours of fog at San Francisco Light.

Industrial Efficiency

Reference Books and Modern Business.—There is a growing tendency in modern business to make the utmost use of reference books and authoritative publications This attitude is not only reflected by the management of large organizations, but even among the men themselves who look forward to books and periodicals to aid them in their work. Many of the more progressive manufacturing firms have already installed reference libraries in charge of skilled librarians for the use of their staff

Counting by Weighing.—No longer is it considered good management to count uniform pieces one by one in manufacturing plants Scales especially constructed for the purpose are now being employed for counting material of like units. Not only is the weighing machine more accurate because it substitutes simple manual operation and the highest degree of mechanical precision for the complicated mental figuring and inaccuracies of other systems, but it counts from 100 to 1,000 per cent faster than the time worn methods

Training College Men for Foreign Trade.—It is reported that a newly formed fifty million dollar corporation, which has for its main object the promotion of foreign trade, purposes to employ a large number of young men and to educate them for permanent positions in the foreign field Most of the young men will be selected from college graduates. If the proposed plan is realized in the future, it will undoubtedly be one of the most important and vital steps yet taken by American business men to secure—and hold—foreign trade.

Physical Examination of Employees.—Arrangements have been made by a Philadelphia gas company and a number of its interests to offer free physical examinations to the employees. It is claimed by the company that these examinations will reveal conditions that have not developed sufficiently to interfere with comfort and usefulness yet which, if neglected would be serious Not a few concerns have already inaugurated the same service and have proved the desirability of the arrangement and its economic value to both employer and employee.

One-Man Street Cars in the Ascendency.—Several cities in the United States are now using one-man street cars with the result that the operating expenses are considerably reduced Double-end cars are remodeled for one man operation by inclosing the platforms, and providing door-operating mechanisms and fare boxes Passengers enter the car at the front end, where a single employee acts in the capacities of conductor and motorman It is reported, however, that ordinances have been enacted in various cities and states prohibiting the operation of one-man street cars.

Solving the Paper Shortage.—The attention of the Department of Commerce has recently been directed to the fact that there is a serious shortage of raw material for the manufacture of paper, including rags and old papers, by the president of a large paper manufacturing company He urges that the Department make it known that the collecting and saving of rags and old papers would greatly better existing conditions for American paper manufacturers. Something like 15,000 tons of different kinds of paper and paper board are manufactured every day in the United States, and a large proportion of this, after it has served its purpose, could be used over again in some class of paper A large part of it, however, is either burned or otherwise wasted—another instance of our national inefficiency

Eliminating the Postage Stamp.—There has lately been placed in service by several American firms with unusually heavy mailings a postage meter which, instead of affixing the usual postage stamps on mail matter, makes an impression in the upper right hand corner The new postal meter performs several tasks, such as sealing, stamping, facing and counting approximately 250 pieces of mail matter per minute The envelopes, unsealed and unstamped are placed in a compartment of the machine much in the same manner as they would be placed in a box, the mechanism handling the envelopes automatically from that point. The stamping mechanism not only makes an impression on the envelopes, but also counts the numbers appearing in a descending serial on top of the stamping meter The meter is so made that its mechanism can only be adjusted by the post office authorities, who set it for the number of impressions the user has paid for When that number of impressions is exhausted, the meter automatically locks and no longer stamps mail matter, necessitating its return to the post office for readjustment The elimination of loss through fire or theft the reduction of handling costs both in the mailer's establishment and in the post office, and the expediting of outgoing mail are but a few of the advantages this system offers over the adhesive stamp method The impressions are not canceled.

RECENT reports appearing in the press have referred to the long distances attained by the projectiles of heavy guns in Europe. It was claimed for instance that batteries established on the French shore of the English Channel could reach England with their projectiles, and some time ago it was reported that projectiles had been fired into Dunquerque from Nieuport, a distance of 21 miles.

These claims are not extravagant, and there would be no cause for wonder if there existed a more general acquaintance with the conditions which govern the flight of projectiles through the air and determine the distances to which they may be thrown, and in view of this, it seems timely to note the salient facts involved in the laws which govern and limit the flight of projectiles.

In the first place other things being equal, the speed with which the projectile is launched, technically called its *muzzle velocity* is of prime importance. The *range* or distance which the projectile traverses before striking is the horizontal distance from the *muzzle* (or mouth of the gun) to the point at which the projectile first strikes the ground. If the gun is level when fired the projectile strikes the ground almost immediately. The distance or range increases as the muzzle of the gun is raised, and this increase continues until the gun has been elevated to an angle above the horizontal approximating to 45 degrees or half way to the vertical position. Upon further elevation of the muzzle the range begins to shorten slowly at first, but with increasing rapidity, until, finally, when the muzzle is pointing directly upwards, the projectile falls back to the ground at the gun.

The simplest case conceivable is that of a projectile encountering no resistance from the air, but simply obeying the downward pull of its weight in conformity with the law of gravity. Such a case is illustrated in Fig 7, which shows trajectories for elevations of 15, 30, 45, 60, 75 and 90 deg. above the horizontal. The muzzle velocity assumed for the trajectories shown is 4 000 feet per second or about 2 700 miles per hour as this is about the highest velocity that has been obtained with projectiles of ordinary design, even with special guns.

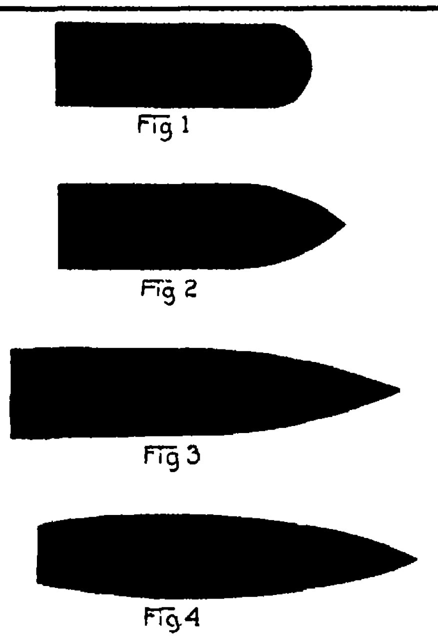


Fig 1

Fig 2

Fig 3

Fig 4

Development in form from the hemispherical head of 1900 to the sharply pointed head and tapered base of today

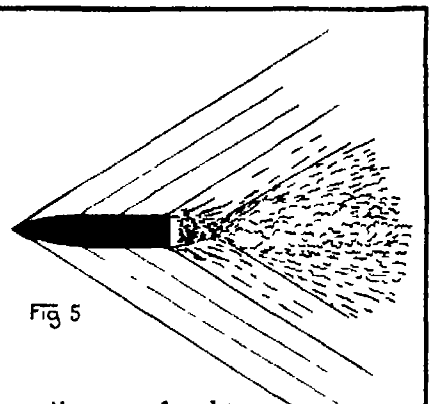


Fig 5

Air waves of modern projectile with pointed head

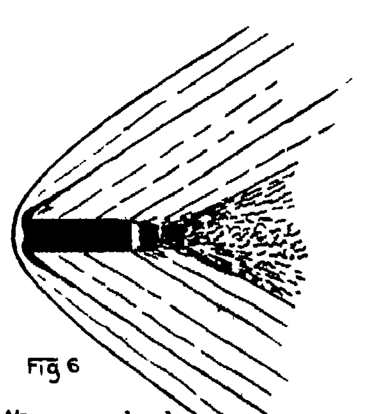


Fig 6

Air waves produced by projectile with flat head

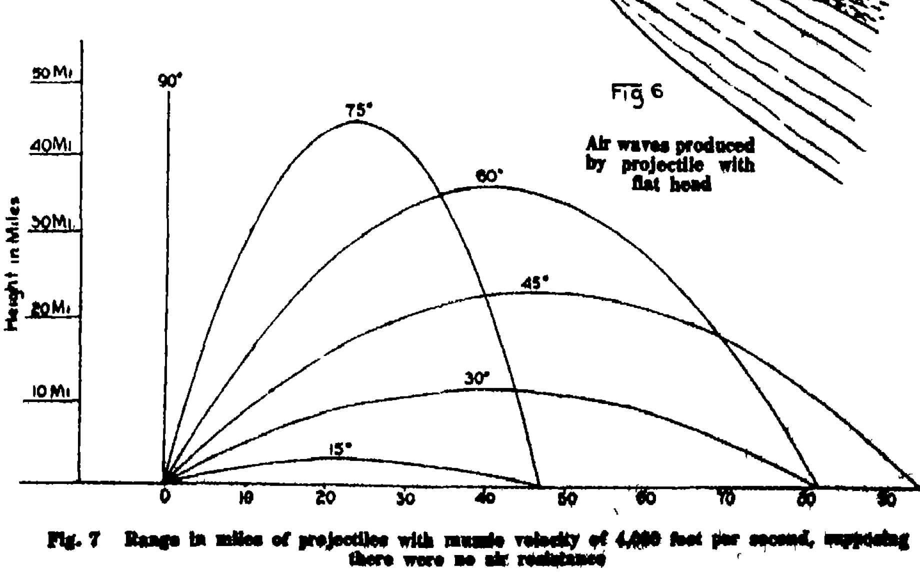


Fig. 7 Range in miles of projectiles with muzzle velocity of 4,000 feet per second, supposing there were no air resistance

It is to be remembered that these are the greatest possible trajectories that could be attained with this high muzzle velocity. For in them there is supposed to be no air resistance, whereas in actual trajectories the resistance of the air materially affects the form of the trajectory and shortens the range. Trajectories of the kind illustrated in Fig 7 may be regarded as the limiting ones to which the trajectory of even the most perfect projectile can only approach.

Examination of Fig. 7 will show that for the unresisted motion there considered, the range at 15 deg elevation is the same as that at 75 deg., though the height of the trajectory in the two cases is widely different. The range for 30 deg. is the same as that at 60 and in general the range is the same whether the angle be measured from the vertical or from the horizontal. The greatest range is at 45 deg.

For other muzzle velocities than 4 000 feet per second, there are given below the ranges in miles, the greatest height attained by the projectile in its flight, also in miles, and the time occupied in describing the trajectory.

Muzzle Velocity f. s.	Range in Miles.	Height Ascended, Miles.	Time of Flight, Seconds.
2,000	24	6	88 or 1 min. 28 sec.
2,500	37	9	110 or 1 min. 50 sec.
3 000	53	13	132 or 2 min. 12 sec.
3,500	72	18	154 or 2 min. 34 sec.
4 000	94	24	177 or 2 min. 57 sec.
4 500	119	30	199 or 3 min. 19 sec.
5,000	147	37	221 or 3 min. 41 sec.

Under the conditions of unresisted motion, the weight and form of the projectile are immaterial. For example, with 4,000 feet per second as muzzle velocity, and without air resistance, an infantry bullet of whatever weight or form would with 45 deg. elevation, shoot 94 miles or from New York to Philadelphia, and would rise 24 miles into the air in doing so. It would occupy a little less than three minutes in making the journey. This performance would be exactly duplicated by the very largest projectile that it is possible or ever will be possible to make.

For identical conditions as to

muzzle velocity and elevation, ranges in air are, in general, far shorter than those just described; and it has been the effort of ordnance engineers to so design projectiles that they shall suffer the least possible resistance in their flight through the air

It is natural that, at first sight, the resistance of the air to the motion of a very heavy projectile should seem an insignificant matter For velocities below about 200 miles an hour, such resistance does not produce any great effect on the motion of projectiles, but, as the velocity increases the resistance increases at a far greater rate, and in practice is of such importance that a trajectory calculated without taking it into account would be hopelessly in error

The size and weight of both guns and projectiles have been greatly increased in recent years. In this way, the efficiency of the projectile in overcoming the resistance of the air has been increased, but at the same time the increase in muzzle velocity which has formed so important a part of the development has entailed correspondingly greater air resistance and has thereby tended to counteract the greater efficiency of the projectile. It was therefore found necessary to seek a form of projectile which would meet with sufficiently reduced air resistance to counteract this adverse tendency This was successfully accomplished by making the head of the projectile longer and more pointed

Originally, the oblong form of projectiles which came into use when rifles were first employed had a hemispherical head or one very nearly so The shape of this head is shown approximately in Fig 1 Fifteen years ago the standard form of head was that shown in Fig 2 At the present time, the commonly accepted standard form is that shown in Fig 3 The curves of these heads are simple circular arcs, that of Fig 1 having a radius of one half caliber (or diameter of projectile), that of Fig 2 a two caliber radius and that of Fig 3 a seven caliber radius There is now a tendency to still further modify the shape of the projectile by employing other curves than simple circular arcs for the head, and, in addition, taper ing the rear portion of the projectile, as indicated in Fig 4

Examination of Fig 5 and Fig 6 will give an idea of the manner in which a projectile generates waves in its progress through the air These figures were drawn after examining numerous photographs of projectiles in flight The camera is able to detect air disturbances that would be invisible to the eye, even if there were time to see them For the velocities in ordinary use, the projectile outstrips these waves and leaves behind it a vacuum the flow of the air into which produces the violent eddies noted in rear of the projectile Tapering away the rear portion of the projectile materially reduces these eddies, but if carried to extremes, it would cause the flight of the projectile to become very erratic The extent to which the tapering process may be applied with practical advantage has not yet been completely determined

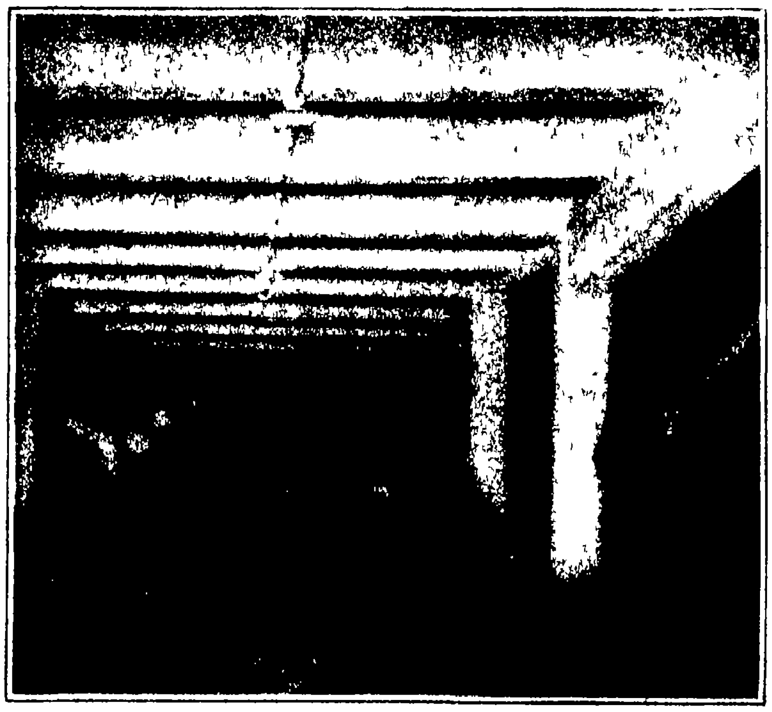
Comparison of Fig 5 and Fig. 6 shows in contrast

(Concluded on page 387)

Conveying and Applying Concrete by Steam

THE concrete contractor must necessarily solve the problem of the economical conveyance of concrete from the mixing plant to the point of use This was a great question at Panama, particularly at the Atlantic locks and the Pacific locks In the one case, it was solved by a combination of tramway and self propelled, movable cableway, in the other by self propelled, movable, T shaped cranes. On one of the great recent viaducts built by the Lackawanna Railroad, derricks were employed At Baltimore, on a big job, a line of elevator towers provided with chutes is being used

What is perhaps the most recent method actually tried out upon important work operates through the agency of superheated steam The concrete is transmitted through a tube by means of steam pressure



Applying crushed marble mortar to the walls and ceilings at the Grand Central Station, New York, with a concrete atomizer

At the point of use the concrete is ejected from a nozzle in the form of a spray Particles and pieces of cement, sand and stone are shot like projectiles from a gun However, the concrete has undergone a mixing process before being sent along the pipe line

Naturally, the concrete is deposited as a layer The thickness may be no more than 1/8 inch or even less or it may be more Layer may be added to layer and any thickness desired built up It must not be concluded from this, however, that the procedure is unsuited for depositing heavy amounts of concrete A rather small machine has transmitted concrete a distance of 300 feet and placed it at an expense of 80 cents per cubic yard, the cost including fuel and labor The expense for a larger machine has been given as 30 cents If, as is claimed, the finished concrete is stronger per unit of volume than ordinary concrete because of increased density, then there will be a further reduction to be taken into account

The general procedure is substantially as follows

The materials are put into one end of the machine where they are mixed mechanically by a device rotating on a horizontal axis During the mixing superheated steam at a pressure of about 80 or 85 pounds per square inch is admitted The result is in part a raising of the temperature of the concrete After the mixing is complete, a valve is opened which admits the batch into a second compartment the atomizing chamber But this chamber and the transmission line into which it opens through a valve, has been previously filled with steam at a pressure of about 35 or 40 pounds Accordingly, the pipe will have been warmed up and also cleared of obstructions The opening of the valve between the mixing and the atomizing chambers results in a transfer of the concrete into the mixing chamber with the possible aid of the mixing paddles The steam pressure will become equalized and the concrete suffer "atomization" Finally when the valve controlling admission to the pipe line is opened, the disintegrated concrete will be forced along the tube

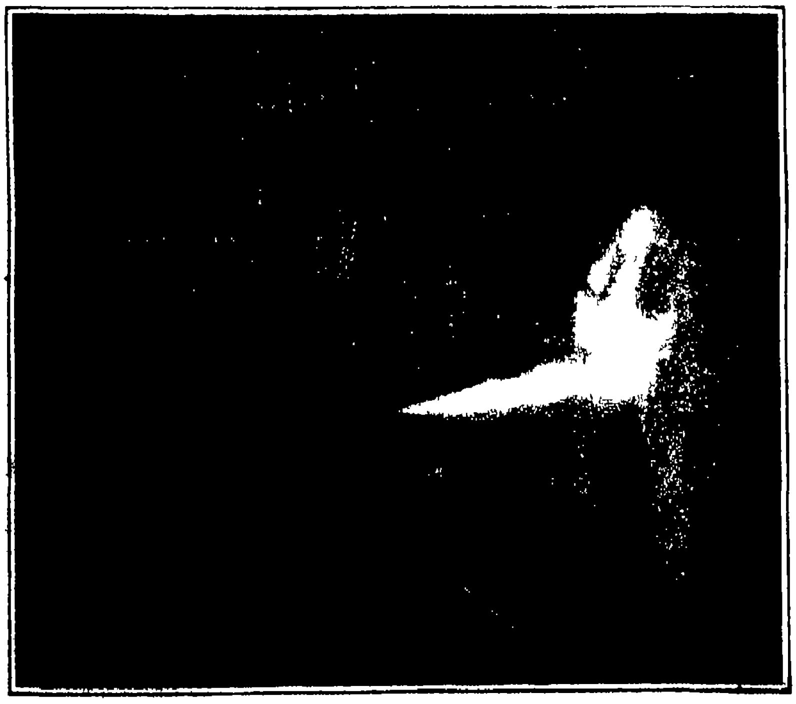
A little consideration will show the importance of preheating the concrete and the transmission line If the steam should condense there would be an instantaneous annihilation of its pressure This is, in fact, one of the principles upon which the condensing steam engine depends for its action Consequently, the steam is used superheated—with heat enough and to spare Further, the steam should be hot enough at the nozzle to maintain itself as steam for a short distance after it reaches the open air This is advisable, though perhaps not absolutely essential If the steam at once condenses, then the spray of concrete will be enveloped in a cloud of steam vapor, with the result that the placing operation is more or less shut off from the view of the man operating the nozzle

The steam method has been employed on good sized jobs for the United States Government and for important railways Some 10 miles below New Orleans, it was deemed expedient to protect by a layer of concrete the face of the levee The steam atomizing process was applied upon this work and a considerable length of covering put on There was no reinforcement employed or any means of securing the covering to the embankment beyond what the method itself supplies. As the particles and pieces of concrete are projected with considerable velocity there is a very considerable tendency to secure good adhesion The embankment is a 1 on 2 slope so that it is not steep The covering was put on 2 inches thick

The Lackawanna Railroad one of the great believers in concrete, utilized the steam method in restoring two old water conduits at Rupert Pa These are waterways which pass beneath a canal bed and supply an ancient mill The diameter is about 5 feet and the original lining was stone The mortar had fallen out to a great extent, leaving the surface extremely

(Concluded on page 389)

General view of the concrete atomizer equipment employed by the Lackawanna Railroad at Newark, N. J.



Applying concrete on a wall, using the concrete atomizer operated with steam

Strategic Moves of the War, March 31st, 1916

By Our Military Expert

FAR reaching activity has become apparent on the Russian front within the past few days It is rather difficult to say at the date of writing which unfortunately is somewhat prior to date of publication whether or not this activity on the part of the Russian forces marks the initiation of a general offensive

There are several reasons for the belief however that the long looked for offensive of the Entente has not yet begun First and foremost is the condition of the ground The rigors of winter have locked the eastern front in an iron grasp up to now and the spring thaw is about to set in During this period the terrain over which most of the line winds will become almost a morass rendering movement difficult in the extreme and complicating the problem of supply for the enormous Russian forces which are already handicapped by a paucity of railway communications, much less efficient and ample than those of the Teutons

The second reason is to be found in the conditions which will exist along a great part of the Russian line with the flooding of the thaw From Riga to the vicinity of Rovno is to be found varying ground Some few eminences establish safe and important posts in the Russian line, but the majority of the line in this extensive section is on low ground, and when the waters of the melting ice-grip begin to flow many of these low positions will be rendered untenable by their present occupants On the other hand, the Germans are generally established on higher ground and the thaw will not have so disturbing an effect upon them It has been said that Field Marshal von Hindenburg comprehended this and halted his autumn drive towards the heart of Russia before it was necessary, in the hope that spring conditions would compel automatically a retirement of the Russian lines to a position a considerable distance to the eastward of where they now are.

The Russian activity, then, may be altogether dictated by realization of the approaching condition and the necessity for either gaining higher ground from the Germans, with the possibility of successful penetration of their lines, or else evacuating a considerable portion of the line

There is a notable similarity between the German offensive at Verdun and the latest Russian movements from Riga to well toward Pinsk It now seems as though Germany's efforts were directed toward removing a possible spring menace against Metz—always with the possibility of breaking the line through fortuitous circumstances, Russia's attack seems to be for a similar purpose, to protect the territory back of her present position But there the similarity ceases, for it also appears as though Germany in her Verdun operations hoped to provoke the Entente into a premature assumption of the offensive, or counter-offensive rather and Russia scarcely entertains such a desire Germany has never yet engineered two major offensives at the same time. There are not the men for it when one considers the enormous number necessary for even one such operation.

A great deal of the ground along the Russian line is difficult in the extreme Southwest of Riga in the Lake Babit section, the marshes of *Marais Tirout* extend as far eastward as Dahlen. For the time being the ground is more favorable along the Dvina high ground marking both banks, through Friedrichstadt and Jakobstadt almost to Dvinsk, where the Russian line stiffened against the assaults the late autumn saw hurled against it

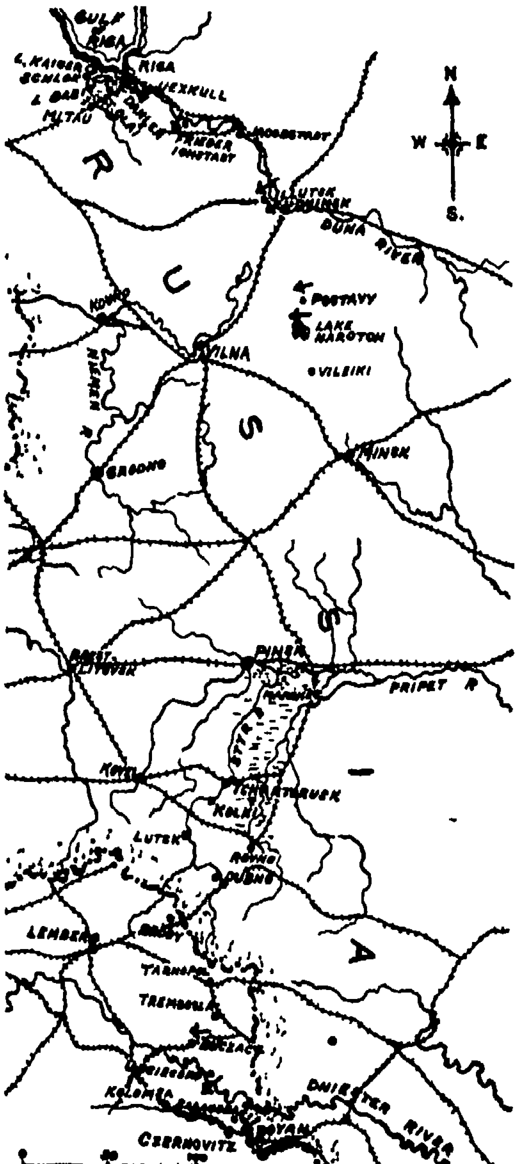
But to the southward of Dvinsk, the real trouble begins. A broken chain of lakes and small, tortuous streams lace the terrain The ground is generally low with frequent marshes, which, while small, are none the less serious obstacles to advance in the modern day of tremendous rapidity and volume of fire South of Lake Narotz, the character of the country is a trifle better for the absence of lakes but still farther south the extensive marshes which begin in the neighborhood of Pinsk, line both sides of the Styr and terminate only a short distance north of the fortress town of Rovno, where reasonably high ground again obtains.

It is clearly to be seen that the position is by no manner of means an agreeable or acceptable one for the Russians Should circumstances demand that the present position be held during a most probable resumption of the offensive by the Germans with the coming of suitable weather, the Russian sectors in the above-described country would be seriously limited

A strong Russian attack has been launched along the Riga Dvinsk Narotz front Success or failure does not now result in a day so it is impossible even to venture an opinion as to problematical success or failure of the attack Where information from the scene of operations is as scarce as it is to-day no man dares prophesy on such scant data, even were he presumptuous enough to try, so time alone can tell the outcome

To a people who are given to thinking—and reading—in headlines, huge numbers of losses are apt to secure consideration for themselves alone without suggesting comparisons, therefore the featuring by the papers of the news item from Berlin that 80,000 Russians have paid the price of attack on a front of 120 kilometers, suggests a little consideration

This loss is comparatively small One hundred and twenty kilometers is about 75 miles, and apportioning the losses claimed by Berlin gives something slightly over a thousand men per mile. Compare this with the Teutonic losses before Verdun—on a front of less extent these losses have been placed at 250,000 men and no one can dare say that a man was thrown away foolishly, for these attacks were pressed home with magnificent courage and impeccable military purpose The losses at Verdun have been six times as great per mile as those of the Russians, reported from Berlin. True—Verdun attacks lasted over a greater span of time, but the relation of attack to attack suggests, first,



Europe's eastern battle front. Russian activities indicated by arrows

that the Russian offensive has not been developed in such concentrated strength and, second, that they have met no such solid defense as has marked the holding of the Verdun lines.

Other, and sporadic activity has developed among the Russians in Bokovina and south of the marsh district, this may portend a real offensive in the section now or later But it is probably merely the accompanying action to larger movements that opposing lines may not be stripped of men for use further north. There seems to be good reason, however, why a strong Russian attack in this neighborhood at the present time might have an important political effect upon swaying Roumania actively to the side of the Entente. While it is generally acknowledged that the individual sympathies of the Roumanians incline toward the Allies, the mere fact that their state has been held concretely neutral accrues as a diplomatic triumph to Teutonia, for tremendous pressure has been brought to bear to precipitate Roumania into the fray

The suggestion that the present Russian activity does not altogether mark the initiation of general offensive by the Entente brings up the question of the long-expected assumption of the offensive by the exterior Powers. Military writers and historians have generally looked for a counter movement to meet the German onslaughts at Verdun, and it has not come, they have predicted—and hailed—such a movement with all the elements of the Entente employed—and it has not come. There must be a reason somewhere, other than seasonal. Perhaps there is a certain dis-similarity to the course of other wars when public opinion demanded action instead of adequate preparation

Those who lived through the turmoil of the American Civil War can readily recall the general cry that surged up during the first two years—" On to Richmond." And history that cannot be denied tells how this cry was heeded against the judgment of military minds and the protests of McClellan, then in command of the field army, with the interfering Halleck, into whose distracted ears the babel clamored, directing operations from a swivel chair at Washington.

The American Civil War and the Franco-German are the bases upon which modern military science has been predicated. Each campaign battle, skirmish, has been conned and the minor deductions consolidated into a whole of theory, precept and axiom And the French staff, as well as the German, has apparently taken the lesson of unpreparedness and premature action to heart At the outbreak of the present war Germany was prepared France, despite popular conception, was not, England was not, Russia was not, Italy took a year to prepare before plunging in The deduction seems obvious

It would seem that some unshakable military council has decided not to be hurried into inadvisable activity prior to full preparation despite the wails and warnings of scribes and dinner table strategists, even despite the natural unrest of engaged peoples, and neutral populaces as well, who know war only by its heroic or dread ful side It is very evident that France was not hurried into a premature offensive return by Verdun and it is a natural corollary that neither will any element of the Entente again essay full strength action until the time is ripe, and the ammunition plentiful Perhaps, after all, a war genius, now somewhere in obscure control of affairs, may yet emerge upon the pages of history's perspective

Extensive Use of Sunglasses in India

IN many parts of India there is extensive use made of sunglasses Most Europeans wear them a good part of the year, owing to the intense glare of the sun. Roads in that country are generally paved with macadam made of white limestone The lack of trees in certain districts to shade either city streets or most country roads and the flat formation of a large part of the country, cause a reflection that is very trying, even when one wears a topee or sun helmet.

Two types of sunglasses are chiefly in use in India One is a glass of the pince-nez variety, with solid rubber sides made to pinch the temples. This gives a double grip and the sides aid in shading the eyes. The second type has sides of cloth, arranged on springs, so that they are held fast to the outside of the eyes at the temples and, with the glass, completely inclose the eye When closed, the side pieces are pressed down by the ear pieces. These glasses are of the spectacle kind. There is also sold, in addition to the two foregoing varieties, a glass of the spectacle kind, which is simply a large, round, colored glass of about 1¼ inches diameter, without side pieces. The colors of the glass used in the sunglasses are green, blue and gray. A kind of modified green is now most popular Gray is not as commonly used as either light blue or green.

Tests for Gum Arabic

A STUDY of many of the published tests for gum arabic, with descriptions of attempts to find others than the few that proved to be reliable, has been published by the United States Bureau of Standards. It was found that basic lead acetate gave the most characteristic reaction, while mixtures of copper sulphate and sodium hydroxide and of neutral ferric chloride and alcohol are of value as confirmatory tests. Dextrin and gum ghatti were subjected to the same tests. A summary of the more important methods that have been proposed for the quantitative estimation of gum arabic is next given, followed by a description of the steps that led the investigators at the Bureau to the use of alcoholic copper-acetate-ammonia solution for the determination.

Naval Consulting Board's Committee on Industrial Preparedness—II

Initial Difficulties Encountered by American Manufacturers in Meeting Munition Specifications

IN our last issue we gave an outline of the comprehensive plan which has been adopted by the Naval Consulting Board's Committee on Industrial Preparedness, for mobilizing the nation's industries for war. It was explained how the committee proposed to make a card index of the manufacturing resources of the country, utilizing for this purpose the services of an expert body of 30,000 of the technically trained engineers of the United States. In the present and concluding chapter we are enabled through the courtesy of Mr Bascom Little, president of the Cleveland Chamber of Commerce, to throw some further light upon the difficulties encountered at the very outset of their work by the concerns in this country which secured contracts for the supply of munitions to the Allied forces

We are informed by Mr Little that the thing which has stirred up the business men of the Middle West has been the extraordinary and totally unforeseen difficulties which the manufacturers encountered at the very outset in their endeavor to make quick deliveries on the contracts which they had undertaken. The problem looked so easy and so profitable when it started a year and a half ago, that everybody concerned expected that right away would be an increase in the dividends of the companies which went into the business. As an instance of the difficulties and delay which were experienced at the very outset, he mentioned the case of a large firm in the West which signed a contract for 250,000 3-inch high-explosive shells. On the face of it this was a straightforward job merely a matter of machining. The forgings were shipped to the company, and they were supposed to finish and deliver them. At about the time when the forgings began to be delivered to the works, information from the front in Europe brought home to the company the fact that this whole order that looked so big to them, was less than one day's supply for France or England or Russia, and the concern realized that within eight months by turning its plant—a first class machine shop—on to this job they could make just one day's supply for one of the Allies. Soon after manufacture commenced, the firm found that it could do everything in connection with the making of that shell very successfully except at one point in the process—the hardening. That was 15 months ago. At the present time the concern has shipped and had accepted 190 000 shells. These however, are not complete, they have yet to be fitted by the fuse maker, they have to be loaded, they have still to be fitted into the brass cartridge cases with the propelling charge and somewhere, sometime, maybe said Mr Little, they will reach the battlefield of Europe. Up to the present time none of them had got there

The same experience has been had in so many plants in the Middle West, that the people out there have made up their minds that if they are ever going to be called on for the service of the nation they have to learn a great deal more about this business of making munitions, they feel that in their present condition of inexperience, in the event of war they would prove to be liabilities to the nation and not assets. Hence the National Chamber of Commerce has been trying to figure out what sort of relation these private plants should have to the Federal Government both in times of peace and in times of war, and it has developed at least to its own satisfaction, the fundamentals of the following plan

The Chamber of Commerce believes, in the first place that there ought to be a contractual obligation or connection made in the open market in much the same manner as a firm would do business with any other customer, but with this main difference that in case of war there should be no excess profit to anybody arising out of the national necessity, that the Federal Government should have the use of the private plants of this country, in case of war, at a living wage to the stockholders (since it is economically undesirable that the stockholders cease to have any dividends from their investment), but that the Government should have the right to take over those plants, with their personnel and equipment, on the basis of a living wage so as to prevent even the suggestion of a profit interest in war. For the National Chamber of Commerce, said Mr Little, feels that it is very unsafe and very undesirable to set up any kind of an organization which will make any part of a community interested in forcing the nation into war; that if there is a war, every person in this nation must accept his share of the national sacrifice and must turn in and work in whatever place his ability, his individual productive capacity, can be best applied.

It was noted in the last issue of the SCIENTIFIC AMERICAN that the National Chamber of Commerce is working in coöperation with the Committee on Industrial Preparedness, and the plan for governmental coöperation as at present outlined is as follows. The proper office in Washington looks over the detailed information regarding the industrial facilities of the country as secured by Mr Coffin's committee, and taking up the case of a certain plant "A" it decides that the equipment of plant "A" is such that it is adapted for making, let us say, shrapnel fuses. The Government then enters into contract with the plant which undertakes to make a complete set of tools, dies, jigs and fixtures for turning the total productive capacity of the plant into the making of that very article. The plant contracts to store that particular article in its storeroom and have it ready, and to pay for that the government agrees to a minimum annual order in peace time for that product. This contract should also carry with it the option to lease by the Government at an agreed upon price, either on a cost plus-a profit basis or at a guaranteed percentage of dividends on the stock. The Government officials would not attempt to operate that plant during war time. The manager, the foreman, the skilled workmen would be back on their jobs the next morning after a declaration of war, doing the same things they did the day before, but they would be in uniform or at least they would wear a distinctive badge showing that they were in the Federal service. The Federal Government gives the plant an insurance policy guaranteeing the return of the physical property of the plant at the end of the war in as good condition as it was when taken over less ordinary depreciation which of course, would be absorbed in the profits as it is in peace-time. It is the opinion of Mr Little that the above plan is a perfectly sound proposition one that will produce the peace time products required by the Government so far as war material and supplies are concerned, and that will produce them at less price than they now cost the country. Furthermore, it will provide an immediately expandible system such that in case of war the production of the country can be multiplied a hundred times within a very short period

Thus far no plant which has a production of less than $100,000 a year is proposed to be included in the organization and it is believed that these concerns (something over 80 000 in all) will gladly enter the proposed organization

Some illuminating facts bearing upon this question of our industrial unpreparedness were brought out recently by another Western manufacturer Mr Henry Souther a member of the Naval Consulting Board in the course of his independent investigation of the ability of manufacturers to accelerate the output of their normal product. He was informed by the president of a large New England firm engaged in the manufacture of firearms that the maximum of their output will not be reached until October of this year. This firm had a factory twice as big as they could use nevertheless that factory will not be full of machinery and producing munitions to its utmost capacity until over two years after it began to get busy on its contract. This firm said Mr Souther knew the game — what then must be the plight of the manufacturer who does not know the game? It is his conviction, and we fully agree with him that if the American public could be made to see and appreciate what a mess we have made of the foreign orders for munitions, and would make of it if we were pressed with war orders for our own Government they would demand that their representatives in Congress put the stamp of legislative approval upon the present plan for industrial preparedness

As showing the many-sidedness of this munitions question—how it bristles with perplexing difficulties—Mr Souther drew attention to the case of the inspectors who are being sent out broadcast in the United States, to-day, to inspect the goods which are being made for the foreign powers. The inspector is generally a green man. He reads certain specifications and he is handed certain gages, but he reads without the necessary intelligence and handles his gages without the proper skill. It is difficult for such an inspector to realize the requirements, let us say, of the base of an ordinary, copper, cartridge-shell. This was illustrated by the rejection of one lot of 80 000 3-inch shells because they were undercut in the primer seat, an error which caused the exploding charge to expand and seize the primer, and so rendered the thing absolutely useless. This rejection occurred simply because the manufacturer, for lack of experience, did not realize the importance of that one little item. It has taken our motor car builders 15 years to get the gears of the rear axle, said Mr Souther sufficiently strong and sufficiently quiet and sufficiently other things to make a good rear axle. How in the world then can the manufacturers of this country jump in and realize at once all the requirements of a rifle of a shell of an aeroplane engine, or any other of the means and implements of modern warfare?

In concluding our digest of the plan of operation of the Committee on Industrial Preparedness we feel that it is only common justice to emphasize the fact that its President, Mr Coffin who is one of the pioneers and leaders of the American automobile industry has been so patriotic as to give his undivided time for a national service without compensation. It is neither fair nor just that this gentleman and others who are associated with him in such work should be asked to do this permanently without full legal authority from Congress, and the question arises as to whether the time has not come when this committee, or the Naval Consulting Board should not be directed by law into a Council of National Defense to sit in Washington. As we pointed out in a series of articles on the needs of the Navy, published several months before the opening of the present war there has been for several years a movement on foot among our naval and military men which has sought to bring before Congress the great need for a Council of National Defense which shall include the Secretaries of War and of the Navy the Chief of Staff of the Army the Naval Aide for Operations the Chairmen of the House and Senate Naval Committees the council to be presided over by the Secretary of State as representing the President. A bill broadly to this effect will be brought up before Congress during its present session and we are strongly of the opinion that both the Naval Consulting Board and its Committee on Industrial Preparedness should have a strong representation in such a council

The Current Supplement

IN the issue of the SCIENTIFIC AMERICAN SUPPLEMENT of April 8th No 2101 will be found *The King of Elephants* an article of special interest describing an immense straight tusked elephant, the remains of which were first discovered in England several years ago, but only recently fully investigated. In size this monster far exceeds that of the great American Mammoth. There are several illustrations including a reproduction of this unusual specimen. A subject that will be of interest and value to a large number of readers is *Making Wild Animals Take Their Own Pictures* which describes the ingenious apparatus and methods by which a busy engineer secured many curious nature pictures. It is illustrated by a large number of cuts showing the details of the apparatus used so clearly that anyone can easily reproduce the outfit. *The Specificity of Proteins and Carbohydrates in Relation to Genera Species and Varieties* is another paper that will be of interest to the scientist. There is a short illustrated description of *The Washington Navy Yard Wind Tunnel* which is used in the solution of various aeronautical problems. The valuable article on *Food Selection* is concluded. When the Parliament Building at Ottawa was destroyed by fire recently quarters for the Dominion Government were immediately provided in the Victoria Memorial Museum. An article by one of the museum staff tells how the arrangements were accomplished, and there are illustrations of the museum and its interior. *Salts, Salt Colloids and Soils* treats of problems of reclaiming and maintaining waste alkali lands. *The Surface Tension at the Interface Between Two Liquids* discusses an important physical problem. Ghost Lines discusses phenomena observed in large steel castings. Other articles of interest are *The Utilization of Peat* *The Ignition of Explosive Gas Mixtures by Electric Sparks* and *Ancient Principles of Physiognomy*

Extermination of Locusts in Argentine Republic

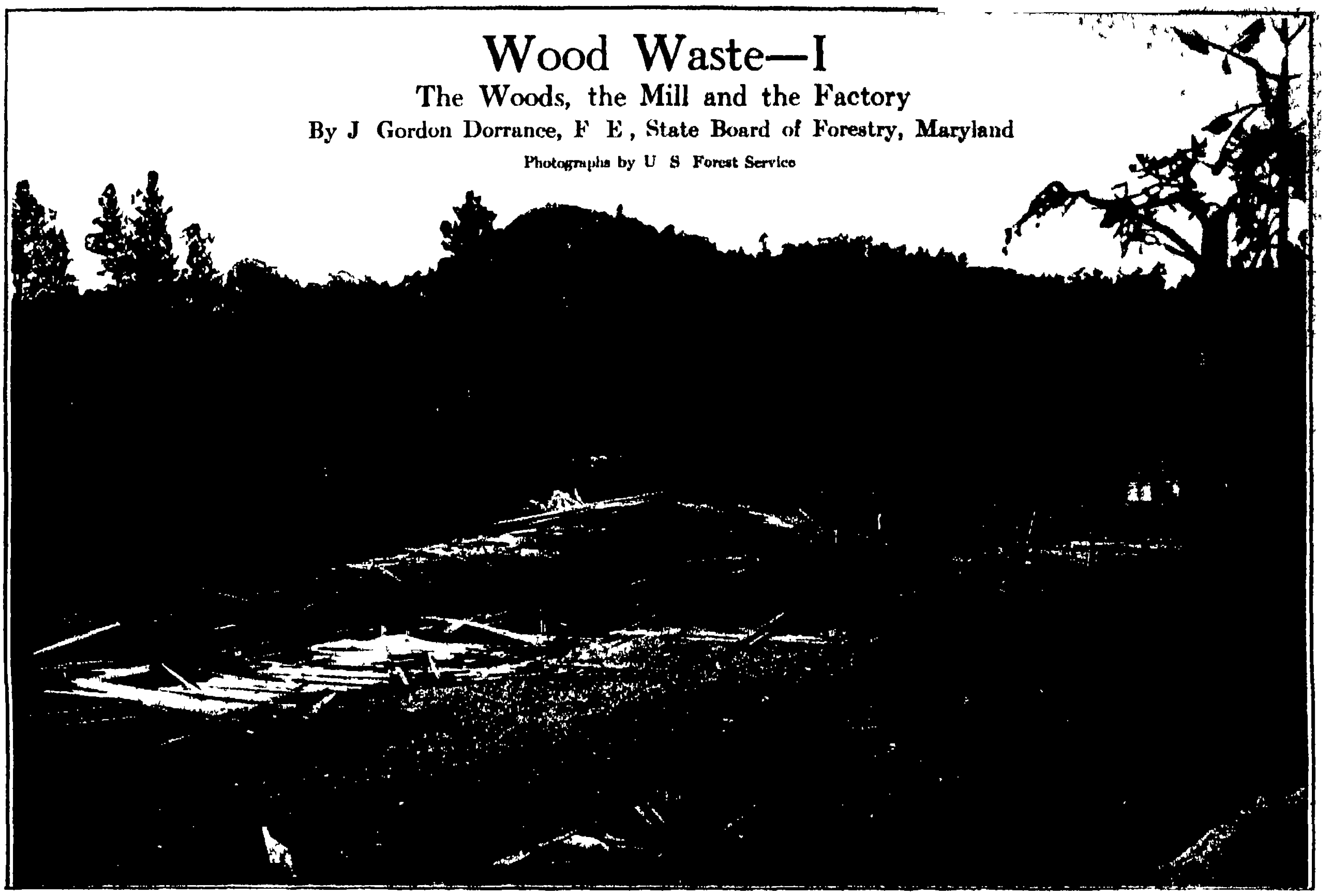
SCIENTIFIC research by the Argentine Department of Agriculture has established the fact that the locust, as well as other destructive insects has a natural parasite enemy. The Department recommends in a recent issue of the *Boletin Oficial* that the directors of the National Institute of Bacteriology and the section of applied zoology of the live-stock bureau coöperate in a study and application of the best means for the propagation of the locust's enemy since experience has proved this method of attack to be most effective in similar cases. The sum of 500,000 paper pesos ($212,300) has been appropriated to be used in various ways in the campaign against the locusts.

Wood Waste—I

The Woods, the Mill and the Factory

By J Gordon Dorrance, F E, State Board of Forestry, Maryland

Photographs by U S Forest Service



Mill waste The sawmill has been, in the past, one of the most prolific of the forest "wasters"

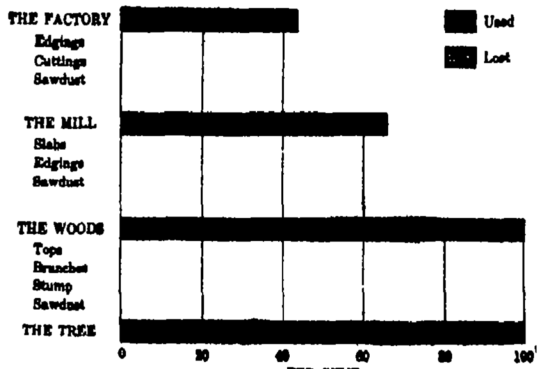
THE first forests of the United States covered not far from 900,000,000 acres of land and their timber exceeded in quality and amount in variety and value that found in present or past times upon any area of equal size They are estimated to have contained in merchantable timber not less than 5,250,000,000,000 board feet. It was not evenly distributed over the country as a whole Along the Atlantic seaboard from Canada southward to the Gulf in the Great Lake regions, and still farther West, were great unbroken areas these areas were interrupted by the Plains but again, in the Rocky Mountain ranges and along the coast of the Pacific, occurred first stands of timber which were remarkable, and which will probably never be found again in any portion of the world

The American, whether the pioneer of three hundred years ago, or the business man of now was rarely backward to see or grasp his opportunity The first thing he saw in America was its forest, and where he went it was the first to go The pioneer settler was the pioneer logger and millman and the early saw mills were never slow to follow the first clearings in the new land where plants for the manufacture of lumber antedated by much over a century those in the land he had left Often this mill was nothing more than a crude improvement of the first pit saw in the beginning operated only by hand but the mills grew with the country, and soon great wheels were being turned by wind or water power—wheels and mills quite often capable of grinding grain as well as sawing boards for their few scattered customers in the American wilderness.

Method of Logging—Old and New

The prime objective in cutting and marketing timber now is money Then necessity was the dictator and very little cash changed hands The *modus operandi* was to clear the land of the old crop to make way for the new The former the forest stood in the way, and it had to go The settlers were the means to the end and their work fitted the needs of the times It was well and thoroughly done Whether by axe or saw by girdling trees or firing the land on which they grew, the cut was clean and the fresh soils set out to other and more remunerative crops. Destructive cutting was no doubt necessary, economically, for them, it may even have been desirable, for it reduced a great surplus

It is neither the one nor the other with us yet signs of the first-comers and their work are visible still whether in the great forests of the South or in the others farther west where, in the piles of waste wood left to rot or furnish a ready tinder for forest fires, in the high stumps in the abandoned trunks of trees, or the sterile eroded lands which often follow such cutting operations there are found fresh proofs of this, all furnishing a commentary on present methods handed down from primitive days There is more waste in the little mill town with its hills of sawdust, and the smoke from hundred foot burners which blackens the sky for each of the 24 hours of the day, and in the city factory's piles of unused wood or the pieces cut up for kindling, sound, clear pieces not large enough for fuel, and yet too good to burn It is quite possible, in the heyday of milling in the White Pine forests of the great Northwest, that a fair sized forest was whirled up in smoke every day, in the sawmill settlements alone, from the scores upon scores of mill engines and great sheet iron burners—the engines doing their duty indifferently on green sawdust and slabs, the burners also doing theirs in a speedy consumption of great quantities of fuel thrown in as offering the easiest and quickest way of waste disposal The White Pine forests are fast going but such methods are not yet obsolete elsewhere



Disposal of wood from tree to finished product

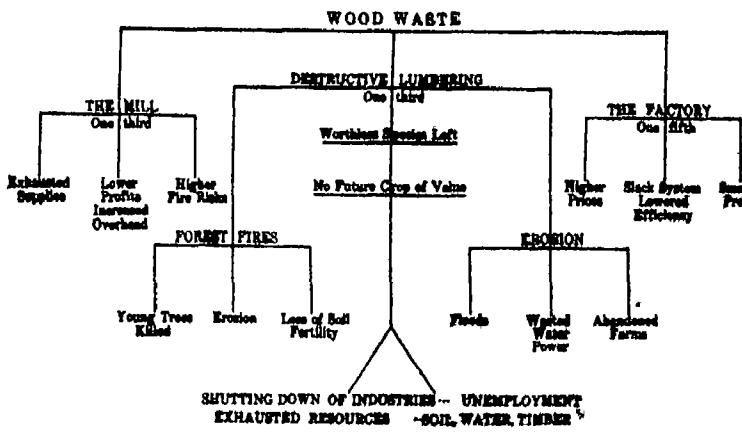


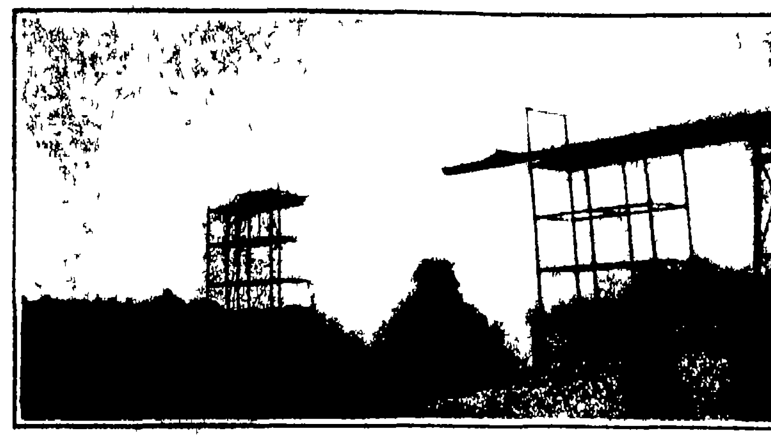
Diagram showing distribution of responsibility for wood waste

Scope of the Industry

It is the well grounded belief of many conversant with these things that the production and manufacture of lumber and timber, and their products, by far exceed in importance any other industry along manufacturing lines Lumber and timber products, at least, maintain first place in so far as the number of their establishments is concerned, branches of the one great industry support more wage earners than any other, they are second in value added to raw materials through manufacture, third in value of their products. Within the decade, 1899 to 1909, there was an increase of 86 6 per cent in wage earners, 51 9 per cent in products. Lumber and timber products, manufactures of lumber, and wood products of chemical processes now require 48,583 establishments, employ 907,514 wage earners, pay $422,764,807 in wages, and have a value annually of $1,582,522,263.

It is probable that the present yearly cut, inclusive of waste, is very nearly 25,000,000,000 cubic feet of wood. This total embraces the lumber production of 21,668 American sawmills, a cut which aggregated, in 1913, 38,387,009,000 board feet, and also, according to some figures of the National Conservation Commission, 100,000,000 cords of fire wood; more than 1,000,000,000 posts, poles, and rails, 118,000,000 hewn cross-ties, 1,150,000,000 staves, 133,000,000 sets of heading, and very nearly 500,000,000 barrel hoops; 3,000,000 cords of pulp wood; 165,000,000 cubic feet of round mine timbers; and 1,250,000 cords of wood for distillation. All this amounts, translated to [illegible] graphic terms, to 246 cubic feet of wood per capita per annum; it is about eleven


Discarded material. Portions of logs that could be utilized


Using fire to dispose of the wood waste of a factory

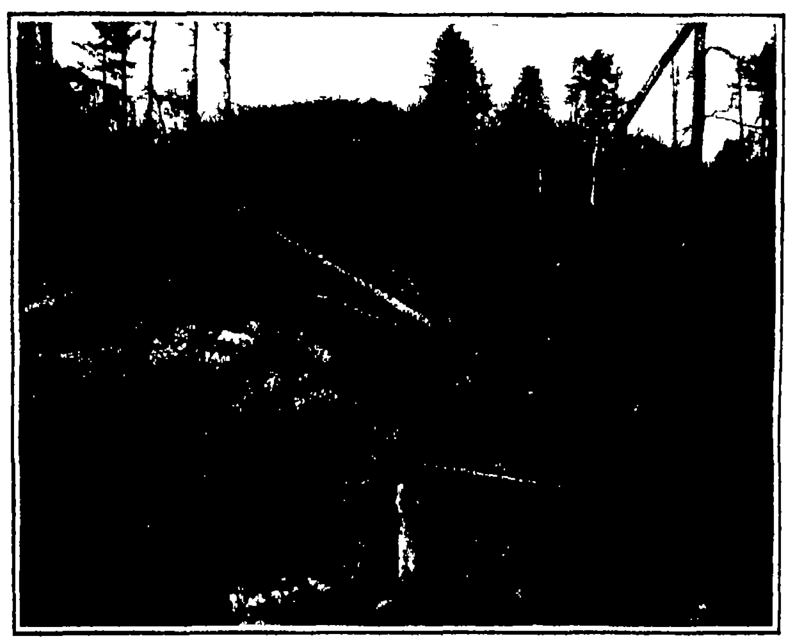
times the consumption of France, seven times Germany's figure, and practically three times the amount which is replacing it through growth. Neither does it include fire or insect damage, together destroying $75,000,000 to $100,000,000 worth of timber annually.

Were this all intensively used for the welfare and upbuilding of our own or other nations, it could, in large measure, be excused as a necessary element of construction and growth. Such a belief would be wide of the mark.

The Woods

Not many years ago I had occasion to visit some original White Pine forests in one of the Lake States, woodland since cut away. At the particular spot I have in mind a large lumbering operation was under way, and there was being carried on a heavy cut, both at the camps and in the mill. It was undoubtedly an average operation, both in stand of timber and methods of removal. Though White Pine was the principal species cut, outstripping other kinds both in value and stumpage, there was some growth of hardwoods, too. The loggers were ordered to cut the pine to a top diameter of 5 inches which meant that the smallest trees, when cut to 16-foot logs, as was the practice there, must measure 5 inches at the smaller end, outside the bark. Hardwoods, clear, were taken to 7 inches, more common grades to 8, and the average stump-height for the smaller trees was slightly over 1 foot, for the larger ones, 2. All White Pine logs less than 12 feet long were left in the woods, as also most top logs which measured less than 10 inches at the small end, though the less valuable hardwoods, having a larger diameter limit, were admitted down to 8 feet.

Other camps nearby were visited, and the practice at the first seemed the rule at the rest. Nowhere was there particular care taken, through careful felling and hauling, for the protection of the remaining young growth in the removal of the old. Immature trees were cut, though later local mill practice showed plainly enough that a 5-inch tree in the log was good for little but a "sappy" two-by four when sawed, and White Pine, matured, has better uses than for dimension. The cut was thorough, as a rule, and trees hollow at the base, yet good enough to have provided seed for another crop, were taken with the rest. At least they were cut. Sometimes they made one short log, and sometimes after felling they were shown to be unexpectedly poor, and lay where they had fallen. The trees of undesirable kinds or sizes, valueless, diseased, or overmature, as the case might be, were left in possession, and the stripped land was sold for poor farms which were rarely successful, because of climatic difficulties, or permitted to revert to the State, for non payment of taxes, as reforestation projects. There seemed hereabout an abundance of projects, but the reforestation was not apparent.


Fuel for forest fires known to lumbermen as "slash"

Stumps of trees which had stood in deep snow were very high, and now and then a tree was seen which had lodged against a neighbor, and ruined both. Visits to former woodland already covered, and left behind showed a large amount of scrubby growth and valueless brush, occasionally a log left in some place which was a little hard to reach, deserted buildings with caved in roofs, their sides still sound and built of good straight logs, here and there construction material in corduroy road or log bridge, no longer needed or in use, simply left because it did not seem worth while to get it out. Farther along were sound sticks half imbedded in the snow, lying where they had dropped from logging cars bound for the mill. The old forest was pretty thoroughly wiped out and there was little for the new save in the lops and tops left piled up anywhere which with the coming of another year perhaps would aid a forest fire in killing the remnants and few young trees which might have struggled up.

The Mill and the Factory

At the mill town was a plant of higher than usual efficiency, half hidden by a mountain of sawdust, while inside hogs ground up more slabs for sawdust to feed the engines or be blown to the hill outside. Trimmers and gangsaws were busied in cutting off defective ends or reducing odd lengths, for the grading of lumber then did not encourage the inclusion of odd lengths and random widths in boards, so that here alone was a daily waste of about 2500 feet of perfectly sound and otherwise merchantable material. The results of this trimming too, together with other slabs and edgings, were conveyed by an endless chain to the burner outside. The mill itself was confidently regarded as one of the best, for it wasted only one third of the logs which it manufactured.

Lumber from the mill was shipped out in a few months, after being air-dried in the yard, to a factory or wood working plant. There some of the sawmill methods and wastes appeared again in great quantities of unusued sawdust and shavings, with numberless long strips and small clear blocks from 2 to 6

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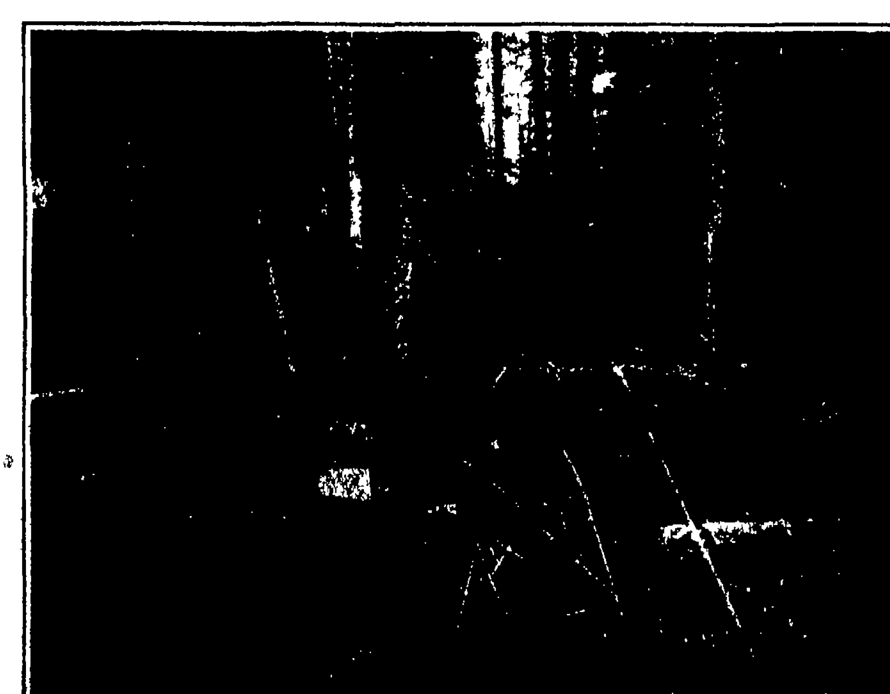
[illegible] forest cover from sloping lands


Stumps and branches left behind as waste

War Game—IV

The Offensive Combat

By Guido von Horvath

THE offensive combat has a distinct and positive aim,– to crush the enemy To accomplish this the forces taking the offensive must have or must gain a superiority The method of directing the offensive in combat is the way of the strong against the weak.

It would, however be a mistake to measure strength by numbers alone Superior leadership is a far greater factor And this factor except in cases where the numerical superiority proves unsurmountable, will be decisive This is the reason that the offensive the aggressive has been the policy the ideal, of every great military leader In the offensive operations of great generals we can find the bravery, the steadfastness and the boldness of genius Even where circumstances make it necessary to resort to defensive action, the going over from the defensive to the offensive at the right moment, the offensive return has always marked the culminating point of superior leadership.

Nevertheless, it would be a mistake to attempt to overwhelm the enemy every where at the same time. Properly, the aim must be to concentrate overwhelming forces and to direct the supreme effort against a decisive point

To accomplish this object all the available forces must be utilized toward one aim, and it will be necessary for every commander to formulate his plans at the earliest possible moment with this one end in view

A study of the offensive action of a Company in the third War Game will serve as an example of offensive action But the knowledge of this is by no means enough to achieve success, many other considerations must be added to gain this end Among these are *The proper employment of all the available forces to prepare the way for the decisive thrust, to attract the enemy's attention and to hold him to the ground where it is most desirable that he should remain, to wear down his power of resistance, to subjugate his will by superior tactics and to force him to submit to the prepared decisive action.*

Try to get a vivid picture of our battlefield in mind and by use of the tactics of the Company, find the way which will enable us to do all these formidable sounding things Our field of action is, in many ways, superior to that of the enemy coming from the north The gently sloping northern side of Lookout Hill gives opportunity for a rapid dash forward, but offers no cover whatever, nor is there a direct chance to get at the enemy in the final attack with the bayonet. The creek will be found a good defensive line as will also the lake

It is evident from Colonel K's order that our forces hastened to occupy Lookout Hill Now let us suppose that they are established on the little plateau around Argus Farm To the right is the rather steep and wooded hillside with railroad and road crossing it, to the left is a far stretch of open country then comes the broad Lebanon Forest This stretch is a little over three miles wide, which is too wide for a force the size of Colonel K's detachment to span What are, and where are the advantages of which we speak?

Let us return to the items which are emphasized in the foregoing paragraph and see what could be done to prepare the way for successful action.

One thing has already been accomplished Colonel K has secured the bridges for the division to cross by succeeding in reaching Lookout Hill, which dominates these bridges

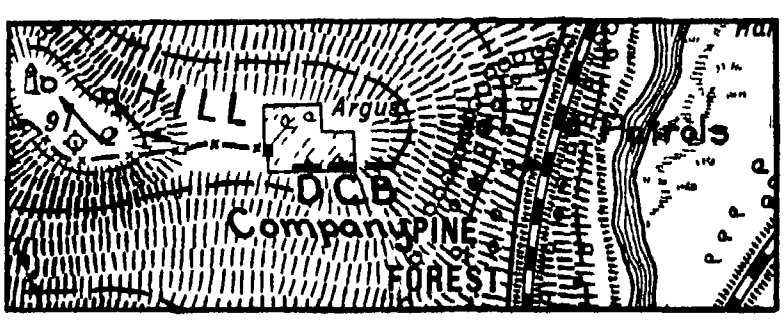
Through this action and Captain C's timely interference and the destruction of the railroad bridge, the enemy has been forced to make a detour More, his attention has been attracted by the cavalry and the artillery The next step is to hold him in the position best suited to our operations. Is Timcum Creek the location desired?

The enemy has occupied the stretch between Nehaminy River and Green's Lake It is a good defensive position, having the flanks well covered by the river and the lake Its left wing is, nevertheless, weak. Pine Forest, with the railway embankment, gives an opportunity for a flanking fire, and if this weak point is the one we select for our attack, we have reached the stage where we must make our plan to wear down the enemy's resistance How shall we do this?

By ordering a part of the detachment to attack the enemy's line and by maneuvering the reserves for the decisive stroke

Here is one more important thing for every commander to remember

The objective of the decisive attack should be struck unexpectedly and with the greatest possible strength.



Enlargement of section A outlined in the map below. This gives the answer to Question 6 of the third game

Plan of relieving outposts. Section B gives the answer to Question 7 of the third game

The Decision and Disposition of Colonel K

Colonel K and his staff are at the northwestern corner of Argus Farm The artillery is in position to the right of the farm, two guns shelling the enemy near Railroad bridge Communication with Captain C of the cavalry is established, and a Company of infantry is on its way to relieve the cavalry. This company serves also as Right Combat Patrol. A half Company is marching under cover to small woods on left flank as Left Combat Patrol. There are no signs of reinforcements for enemy

Having estimated the situation, Colonel K makes the following decision

"To attack the enemy along the lower portion of Timcum Creek First Battalion the firing line. Direction, the bridge Two Companies of Second Battalion as Artillery support on the edge of Pine Forest. Third Battalion reserve behind the center Half Second Battalion and Fourth Battalion Detachment reserve behind the right flank on forest road."

Just as a steel spring upon being wound will set the mechanism of a clock into action, so these probably abrupt and, to the layman, somewhat ambiguous sounding orders from Colonel K will start the mechanism of this military machine into motion.

Imagine yourself there, accept the rôle of a Battalion or other commander on the field, and fully grasp the importance of these pictures given you. A moment like this, on the field of action, is a glorious one The bloody shadows do not dull the eager and chivalrous desire of each soldier to match his own and his commander's skill against the enemy

On the top of Lookout Hill four Battalions of Infantry, one Battery of Artillery, a Platoon of Engineers are in position. Only the first Battalion has thrown forward a skirmish line, the rest are in column, awaiting the moment of action.

On the edge of the woods the light skirmish fire of the cavalry and the enemy are pattering, now and then the boom of the enemy's cannon sends a thrill through the veins of the waiting troops Officers, watchful, expectant, eager, await the beginning of the actual fight.

This was the picture up to the moment Colonel K made his disposition Now the expectant attitude, the nervous standstill, is broken, cool energy and eager action have taken their place

The Battalion commanders give their orders and, with the skirmish line moving toward the enemy, the different reserves go to their positions, and the picture now develops into an offensive combat.

These movements, told calmly and simply and expressed plainly on the map, are, in actual battle, difficult and full of danger—but danger is the spice of life for a soldier

Colonel K's ambiguous sounding orders are translated as follows The fact that he intends to attack the enemy along the lower shore of Timcum Creek is quite clear For this purpose we see that he is using the first Battalion as a firing line.

Why not more?

For the reason that this one Battalion will hold the enemy's attention; it will keep the enemy, or parts of the enemy, in line, and will wear down its resistance.

Colonel K sends only this one unit to the firing line because he wants to hold the reins of action as long as possible in his own hands. For once a force is sent on the line it must remain there until victory has been achieved, or defeat suffered. To attempt to withdraw troops under fire would result only in disaster.

This is why Colonel K retained three fourths of his forces; he has, through this measure, insured a longer influence upon them.

Why did Colonel K say, "Direction, the bridge"? Everyone knew that the enemy was along the creek. What was the reason for indicating the bridge as direction?

The objective, the aim to be reached, is the important factor in the development of the attack, and must be clearly indicated.

The enemy commander, as well as Colonel K, will use every means of covering his actions. He will make every use of the ground and improve it by artificial means. The enemy, therefore, will not al-

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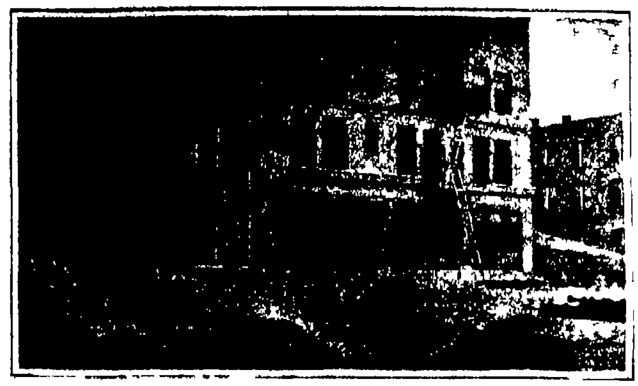
Hotels Built With a View to the Future

THE owner of a property in Los Angeles—a lot upon a very steep hill—is now reaping the reward of his good judgment in providing for changes that he felt certain were coming. He believed that a business street running on a stiff grade would have to be lowered sooner or later, and so when he built two large hotels of concrete and masonry, he provided for this contingency.

Hotel as it appeared prior to lowering of street level



Hotel as it appeared after the street level had been lowered, showing the conventional type store fronts

The buildings were provided with ground floors that were set about 16 feet below the level of the sidewalk. These were not mere basements but carefully planned quarters for business purposes, and for years these quarters have been awaiting the change in grade which has just taken place.

Broadway for a block or so leading to the North Broadway tunnel was cut down from a six to three per cent grade, involving a drop of 20 feet at the portal of the bore and a lowering of the tunnel, and before the hotels mentioned, the cut amounted to about 16 feet, the estimated distance when building was begun some years ago.

When the steam shovel began operations, it would have been necessary to make extensive changes in most structures; new foundations would be required, the underpinning of the walls would be needful and in general the rebuilding would be so extensive as to disarrange the business of the hotels and drive out the guests.

In this case, however, the work had been done in advance so skillfully that little alteration was required. When excavating began on the street a trench before one of the hotels had been already dug and workmen were engaged in setting plate glass show windows in place and in surfacing the concrete walls which had been left rough, while they were below the surface. Then when the street and sidewalk were dug away by the steam shovel, the building was disclosed with a main floor added, and it was all ready for occupancy.

Motor-Driven Apple Grading Machine of High Capacity

AMONG recent labor saving devices is an apple grading machine that has attracted much attention in the apple growing states.

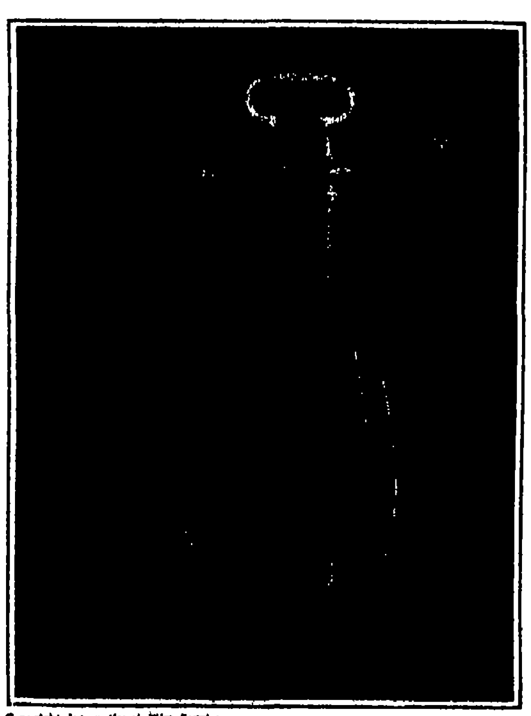
The new apple grading machine is operated by motor power and has a capacity varying from 40 to 60 barrels per hour, according to the size of the apples and the speed at which it is operated, the latter being variable to suit requirements. The apples can be graded in seven different sizes from 2¼ inches up to 4½ inches in diameter, each size varying one quarter of an inch. Although the machine is highly efficient in its work, its design and construction are of the most simple form possible. Briefly, the principle involved is that of an endless belt, with plates forming hollow squares which change their size on an ascending scale as they travel towards the end of the grader. The variation in the size of the squares is accomplished by the spreading of the belts.

With the use of the new apple grader, there is no possible chance for the apples to vary in size since the fruit can not fall through any hole until it reaches the proper size. With the old system employed in the roller grading machine the fruit could fall crosswise between the rollers and be carried to a wrong pocket. During the past season the new apple grader has been tried out and the results are said to have been most satisfactory.

An apple grading machine which operates on the principle of spreading belts

Pumping Air Into the Lungs to Save Human Life

CLAIMING utmost simplicity and efficiency as its cardinal features, a device known as the Lungmotor and intended to stimulate natural, normal breathing in the resuscitation of victims of drowning, electric shock or asphyxiation, has recently made its appearance.



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The Lungmotor—a device used for stimulating breathing in victims of drowning and asphyxiation

Showing the double pump mechanism which is operated by a common handle, and the face mask with its connecting tubes. Because of its light weight, the device is readily portable

The Lungmotor is unique in that it is little more than a form of double pump and its operation is not based essentially on the use of tanks of compressed oxygen. The two air pumps operate in unison since they are connected to a common handle. The construction is such, however, that there is no interchange of air between the pumps so that at no time does the devitalized air come in contact with the fresh air or oxygen. The operation of the device is simple: an upward movement of the handle fills the pressure cylinder with air or oxygen—the latter if the small self-contained oxygen generator which is included in the outfit is employed—or a mixture of both according to the setting of the air and oxygen valve. At the same time the suction cylinder fills with expired air, very gently drawn from the lungs of the subject. Conversely, the following downward movement of the handle and piston forces the air and oxygen now contained in the pressure cylinder into the lungs of the subject and discharges the expired air of the suction cylinder into the open. In many cases air alone is used with the Lungmotor, with satisfactory results.

In order to make the Lungmotor available for persons of all ages and corresponding varying lung capacities it is provided with adjustments for different air volumes, suitable for new born, five-year old, ten year old, fifteen year old, and small, average and large adults. This range provides for all sizes of subjects. The device does the very next thing to normal breathing because it supplies, mechanically, the tidal volume of air each respiration—a quantity of air equal to that which the patient would breathe while at rest, yet not so much as to possibly injure the lung tissues and the circulation, thus not leaving the patient liable to pneumonia following.

The Brooks Aqueduct of Canada

THE Brooks Aqueduct is, next to the great dam at Bassano, the most important engineering work in the Eastern Section of the Canadian Pacific Railway's Irrigation Block in Alberta. The Irrigation Block is divided into three sections, Western, Central and Eastern, each approximately 1 000 000 acres in area. The Western Section has been practically all settled, the Central Section has not yet been developed, while the work of colonization in the Eastern Section has just begun.

The water supply for irrigation purposes is obtained from the Bow River, but the Eastern and Western Sections are independent of each other, with separate intakes, the latter immediately adjoining the city of Calgary and the former near the town of Bassano, some 80 miles east of Calgary. About 4 miles from Bassano a great dam has been erected across the Bow River, which has raised the level of the river 46 feet and formed an enormous pool from which is diverted into the main canal the water required for the whole Eastern Section, which contains approximately 440 000 acres that either can now or will ultimately be irrigated.

The main canal leads away in an easterly direction for about 5 miles and is then divided into two branches, going respectively north and east. The east branch, after having several smaller branches taken off, discharges the majority of its volume into an artificial reservoir that has been formed in a depression in the hills, and which is named Lake Newell reservoir. It has a storage capacity of 187 300 acre feet or over 60,000,000 000 gallons and is designed to be filled during the non irrigating season.

A marked feature of the topography of this section is the existence of several deep valleys, one of which

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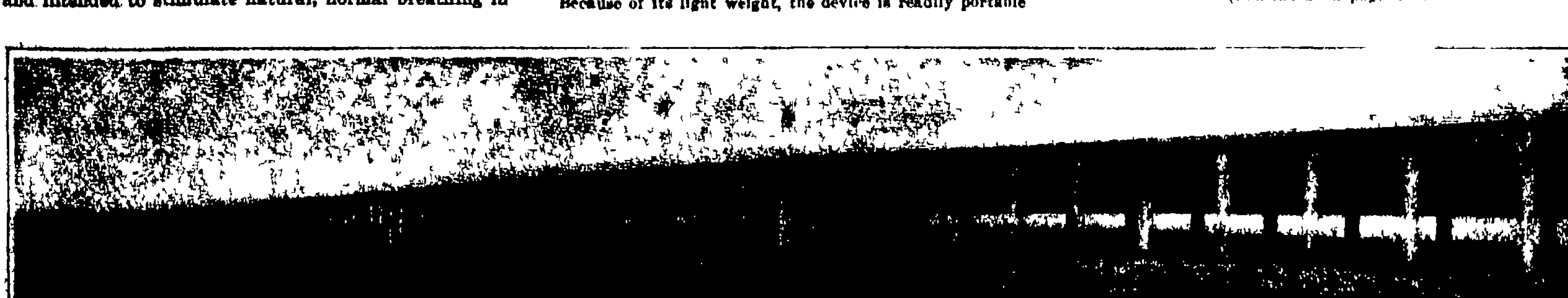


General view of the Brooks aqueduct in Alberta, which consists of a concrete flume 10,480 feet long

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

ADJUSTABLE SHIRT SLEEVE.—P THORMAN 1027 Tremont Ave Bronx N Y N Y This invention provides means at the end of the cuff of a sleeve whereby the ends can be elastically connected for the purpose of enabling the length of the sleeve to be adjusted the cuff to be turned up so that the outside of the cuff will not become soiled and whereby the sleeve can be adjusted to half length like the sleeve of an ordinary sport shirt

FIRE HELMET.—J A TYCHON 610 Cloquet Ave Cloquet Minn The improvement relates more particularly to a helmet with means adapting the same to operate as a respirator in addition to the protection it affords the wearer It provides an equipment including an air intake box which may be readily adjusted by the user to suit various conditions of use

SHOE STRETCHING DEVICE.—W B CRANDELL Mount Pleasant Iowa This inventor provides a device for softening and stretching the leather of a shoe at any point where the shoe may bind the foot of the wearer

SHOE STRETCHING DEVICE

in order to relieve the pressure on the foot the device employing means for primarily smoothing and tightening the leather to prevent its wrinkling or folding and secondarily stretching the tightened area to the desired extent

Electrical Devices

FASTENER FOR TELEPHONE TRANSMITTERS.—A J GATTERMEIR Box 278 California, Mo The object here is to enable the transmitter to be removed or replaced in a fraction of the time usually involved by the use of screws, to enable the transmitter to be removed without the use of a screw driver or other special tools to prevent annoyance and loss of time due to the loss breaking or wear ing of screws and like fasteners and to provide a very neat fastening means so as to give the transmitter an improved appearance

Of Interest to Farmers

YIELDING MOUNT FOR PLOWS AND OTHER TOOLS.—F DUNLAP Box 23 Diamond Spring Cal This invention provides a mount for plows and other tools, which will permit the plow or other tool to pass over an obstruction, such as a stump or rock and still make it impossible for the plow or other tool to be drawn out of line when passing through an obstruction of less resistance, such as a hard spot in the soil

BEAN HARVESTER.—F H QUANCE, Crosswell, Mich. The invention provides means for cutting off the stalks at any desired distance above the ground, delivering the same to a receptacle therefor and when desired removing the stalks so delivered from said receptacle all the parts being carried upon a pair of wheels the revolution of which actuates the mechanism when such actuation is desired

NEEDLE AND GUARD THEREFOR.—A L POWELL, Alamo Tenn This invention relates to grain harvesters and binders It provides a needle and guard therefor, arranged to permit of using a needle without a crank arm, and thus allow of swinging the needle downward without danger of striking the ground, the needle guard serving to cut off the loose grain from the needle and to prevent it from passing in behind the needle and clogging the movement thereof

Of General Interest

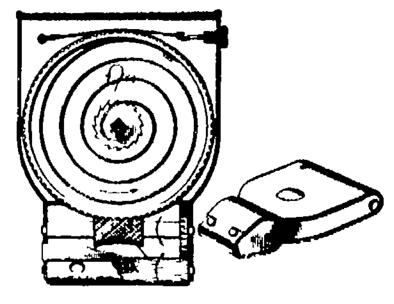
ROOF COLLAR.—O M REDLON 181 Front St Bath Maine In this case the invention relates to a collar to be placed on a roof around a vent pipe or the like and arranged to secure the flashing An object of the invention is to provide a collar having a wide range of adjustment to conform to the particular pitch of a roof

OVERSHOE FOR HORSES.—MABEL BLACKMAN 204 W 82nd St, New York N Y This invention provides an overshoe with removable wearing members and a rigid sole plate partially covering said wearing members; provides means for readily attaching and detaching the shoe and provides means for preventing rattling or jamming of the parts of the shoe

Hardware and Tools

MACHINE FOR REMOVING GRASS.—C W HEASLEY Grangeville, Idaho. This invention is an improvement in machines for removing grass, and the object is to provide mechanism in the form of a cutting disk for cutting the grass below the surface of the ground and for lifting the cut grass and soil, and delivering it to separating mechanism

RAZOR.—W A FINCH Room 8, Stine Bld'g, Decatur Ill This invention relates especially to that class of razors in which a motor is employed and has for its object to simplify the present method of shaving or removing the



RAZOR.

beard from the face avoiding the necessity of lathering the face etc as is required by the present type of razors another object is to produce a small and compact device that may be carried in a vest pocket and one which does not require sharpening being self sharpening

OIL WELL DRILL.—W S IAMS Cushing Cal One of the principal objects of the improvement is to provide a drill with means for preventing the drill bit from loosening in the well said means adapted to act as a core or lock whereby the drill stem and jar may be raised from the well should they become broken

Heating and Lighting

DETACHABLE COUPLING FOR ELECTRIC FIXTURES.—J M CRULEY and M H GOLDSMITH Address the former care of Crucet Mfg Co 256 W 28th St New York N Y This invention provides a detachable coupling and system of wiring for electric fixtures or a device for attaching and detaching brass or other electric fixtures to all styles of portables electroliers and hanging electric light fixtures whether of wood metal china glass composition fiber or any material used for such portables electroliers or fixtures whereby a fixture having any number of light sockets can be employed without rewiring the portable, electrolier or fixture

Household Utilities

AUTOMATIC DRIP COFFEE POT.—O W CHAMBERLAIN, 2014 State St, New Orleans La This invention provides a construction wherein the water is designed to pass through the coffee grounds but once It provides a construction of coffee pot wherein the made or completed coffee is maintained normally with out in any way coming in contact with the grounds

ADJUSTABLE SWATTER.—A V KELLY 507 Park Place Brooklyn N Y N Y This improvement relates particularly to an adjustable swatter for use in killing flies mosquitoes and the like either on the ceiling of a

ADJUSTABLE SWATTER

room or on the walls When used on the ceiling it will strike the same in a flat condition or when used on the wall will strike the wall in a flat condition and thereby kill the fly or mosquito without injuring the wall.

Machines and Mechanical Devices

PILE EXTRACTING MECHANISM.—A R CUTHBERTSON, Turners Falls Mass This invention relates to a mechanism for extracting or withdrawing piles, sheeting and the like It also provides such a mechanism whereby a continuous and an intermittent pulling force may be applied simultaneously to the pile or sheeting whereby to withdraw the same

THREAD CUTTING ATTACHMENT.—C W CAMMAN care of Empire State Bag Co., 700 Wythe Ave Brooklyn N Y N Y The invention provides an attachment for a sewing machine, arranged adjacent the path of travel of the material being sewed so that the operator may cause the same to be severed by a slight turn of the thread connecting a series of articles provides means for severing a continuous thread uniting the articles manufactured in chain form, and provides a mechanism for employment in types of sewing machines known as factory machines.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper

The Brooks Aqueduct of Canada

(Concluded from page 385)

is situated just east of the reservoir It is about 2 miles in width, and to cross it an aqueduct has been constructed; an aqueduct being chosen, after some consideration, in preference to a siphon—a type of structure which has been used elsewhere in the irrigation block.

The aqueduct is supplied by a short canal from the reservoir It consists of a reinforced concrete flume 10,480 feet in length, having a curved cross section, about 23 feet in width at the top, and nearly 9 feet in depth from the top full flow water level to the center of the curve at the bottom This will carry water for the irrigation of 125,000 acres of land, and its discharge capacity is 900 cubic feet per second The eastern end is between 4 and 5 feet lower than the western end, causing a grade for the water flow

The flume, which is 5 inches in thickness, is suspended between horizontal girders, the whole being supported by a reinforced concrete trestle made up of two lines of columns which vary in height according to the contour of the valley The maximum height is 60 feet

At about 3 miles east of the town of Brooks, the site of the aqueduct is crossed by the main line of the Canadian Pacific Railway The track is at such an elevation that sufficient room for the flume overhead could not be found A siphon under the track was therefore necessary At the west side of the track the curved form of the flume is continued round until a completely circular pipe is made which dips at an angle of about 45 degrees and enters the ground, which it traverses under the rails at a slight depth for a distance of about 55 feet, when it rises again to the original level and reverts to the original form This siphon is 9 feet 9 inches in diameter at the smallest and 12 feet 8½ inches at the largest

War Game—IV

(Concluded from page 384)

ways pose for us in order to give us a chance to take careful aim There is an other reason for such an order the attack should be concentrated on a certain point to assure decisive success for the offensive

When Colonel K gave the 'direction as the bridge, it meant that the space of action for this First Battalion was reduced to a limited front on the field of action

The necessity of the support for the Artillery is so clear that it needs no special discussion.

The reserve behind the center is, to use a striking simile the cards with which we play the game, to gradually bring forward the line of attack. While the reserve behind the right flank is the highest trump, which, if played out in the right place and moment, will bring about the final results.

Questions

Question 1 Considering Colonel K's order formulate an order as though you were the commander of the First Battalion.

Question 2 Captain C receives the order to lead the covering detachment to relieve the Cavalry How will he proceed? What will be his chief aim as Flank Guard?

Question 3 Make an enlargement of the field of action on a scale of 6 inches to a mile Draw or mark in with pins the position when the First Battalion opens fire Locate the reserves, Artillery, its support

The Defensive Combat

The stronger man is not always the offender, nor is the stronger general always on the offensive. Back of all successful defensive operations must lie the spirit which watches for the opportunity to take the offensive to deliver a crushing blow when and where it is least expected, and with the greatest possible force.

The chief advantage of the defensive is the chance to hold a numerically superior force at bay, to wear this enemy down during the approach and fire combat by a deadly and accurate fire. And, finally, when through the wearing power of a withering fire, the balance of power begins to lean toward the defender, to take the offensive and strike hard.

In our case the numerical superiority of Colonel K's detachment is evident. He has one Battalion and a platoon of Engineers, more troops, as well as a superiority of the Cavalry, at his disposal. He feels himself the stronger, and he has the conviction that, through an offensive, he will accomplish the task of securing the bridges across the Nehaminy River above Pottstown.

We will now join the enemy forces and consider their problems.

Lieutenant-Colonel LC, on Chester Hill, close to the railroad, commander of the invading force, has many difficulties to overcome in regard to the land, topography, etc.

He has, however, a great deal of information concerning the strength, the composition and the mission of Colonel K's detachment Furthermore, he is in signal communication with a patrol on Paoli Hill, which informs him that at 10 30 A.M. strong enemy forces were nearing Norrisville from the south A staff officer arrives at 10 50 A.M. from the north with a message that a regiment of cavalry is at that moment passing Greenville to reinforce Colonel LC's detachment

At this moment the combat is already in its first stage

Lieutenant Colonel LC receives orders from his headquarters to hold Timcum Creek line till 4 P M, and if enemy is not shaken then to retire toward Greenville Considering the perspective which shows the layout of the country very clearly and the developments of the battle at 11 30 A M and also making a study of the map to find an advantageous point for the counter offensive we shall consider the following questions

Question 4 How much force will Lieutenant-Colonel LC put in the firing line?

Question 5 Where will he place his reserve?

Consider here the point which will become the center of the offensive action.

Question 6 Where will the Artillery be located? And why?

These questions will be answered in the next issue of the SCIENTIFIC AMERICAN

* * * * *

Answers to Questions in War Game III

Question 1 See map where route of returning outpost is marked

Question 2 The order given by the commander of the outpost Battalion would be as follows

"The enemy is advancing on Pottstown Our detachment shall march immediately to Pottstown

"The outpost is relieved It will assemble at Railroad bridge and take its place in rear of column

"One platoon from D Company rear guard

"I shall be near bridge"

Question 3 The bridge was blown up.

Question 4 Under the circumstances, the advantages offered by the occupancy of the hill across the river demand that the Detachment commander exert every effort to secure and hold same

Question 5 The Battalion, after disembarking from train is still over two miles away from top of Lookout Hill This means a march in the direction of the enemy Therefore, the first action must be to take security measures by sending out an advance guard

For the time being, the Battalion is a detachment and must act as such However, the nearness of the enemy makes it imperative that the advance be made with great caution, and to this end a forward movement in line, after the passing of the bridges, will insure greater security, especially if small patrols are moving ahead, searching out the territory.

According to this, the Battalion will cross the bridges with an advance guard and, [illegible]

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trols as Flank Guards are automatically placed

Question 6 See diagram
Question 7 See diagram

Occurrences of Importance

Colonel K's detachment has advanced 1,000 yards toward the defensive line at Timcum Creek

To simplify matters, we shall call Colonel K's detachment from now on "the Blues," and the enemy, coming from the north, "the Reds"

The Reds have developed a withering fire, and with the effective work of their Artillery on Chester Hill, forced the Blues to slow advances However, on their right flank under cover of Pine Forest, they push forward to 500 yards' distance and with the reserves, are getting ready to make another rush before attempting the assault on the Red's left flank

At this moment orders are received from Colonel K who directs the combat from Argus Farm, to hold the edge of the forest and not to attempt the assault

At 1 o'clock the left flank guard receives the attack of two squadrons of Red cavalry from Lebanon Forest, and is swept away

At this time Red reserves are thrown into the line on Timcum Creek and their Artillery directs a furious fire on the center of the Blues

* * * * *

The further developments of the combat will be worked out in War Game V

The Extreme Ranges of Modern Guns

(Concluded from page 379)

the smooth progress of the modern projectile with its pointed head, and that of a projectile with a perfectly flat head The relatively huge bow wave of the latter is to be noted as well as the wave preceding it The two figures illustrate well the advantage of a projectile with fine lines, and the comparison is like that of a scow with a racing yacht

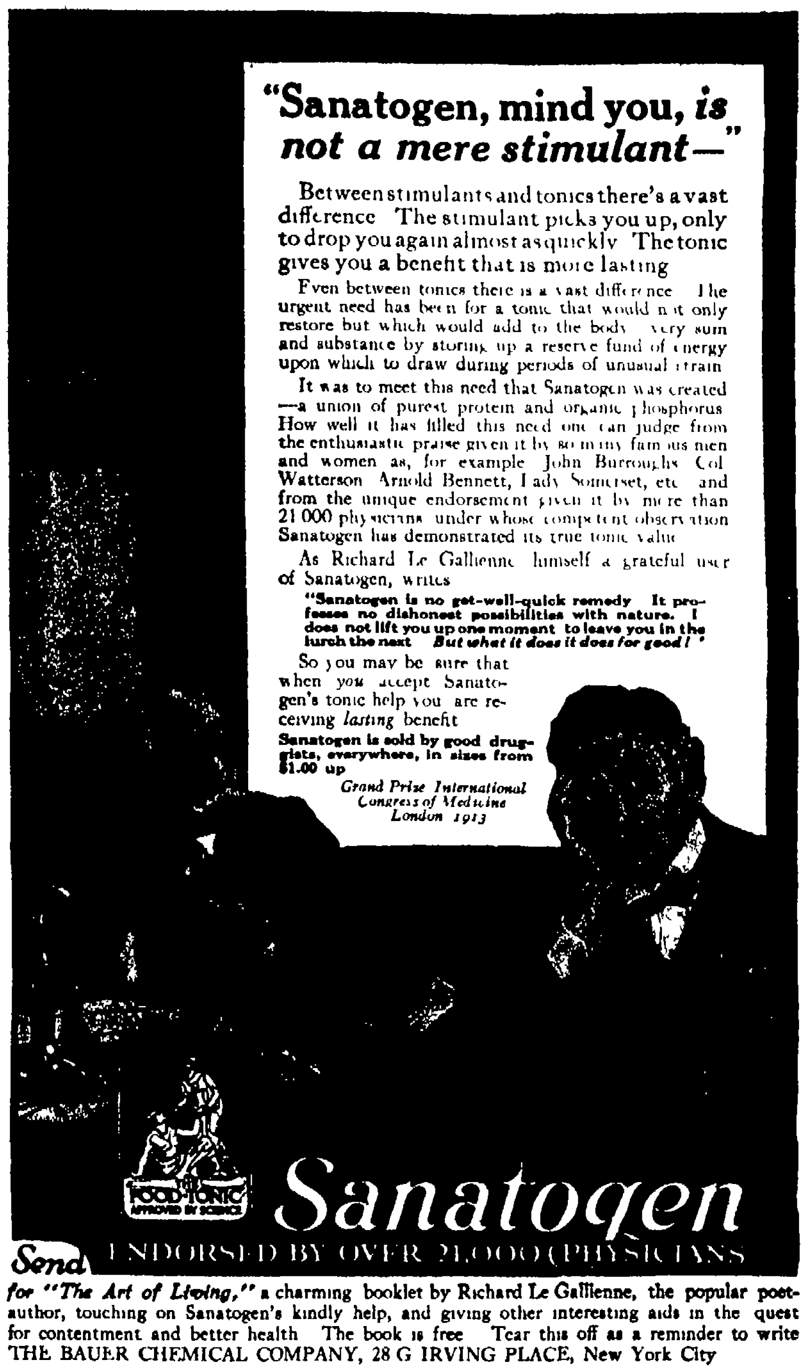
The head shown in Fig 2 offers but two thirds of the resistance incident to the use of a head like that shown in Fig 1 while that in Fig. 3 offers but one third of that shown in Fig 1 and but one half of that shown in Fig 2 It is at once seen that the resistance has been reduced to one third of its original magnitude by actual improvement in the shape of the point alone The reason for this is that the rifling of the gun causes the projectile to spin around its axis like a top, and this action causes it to present its head alone to the air

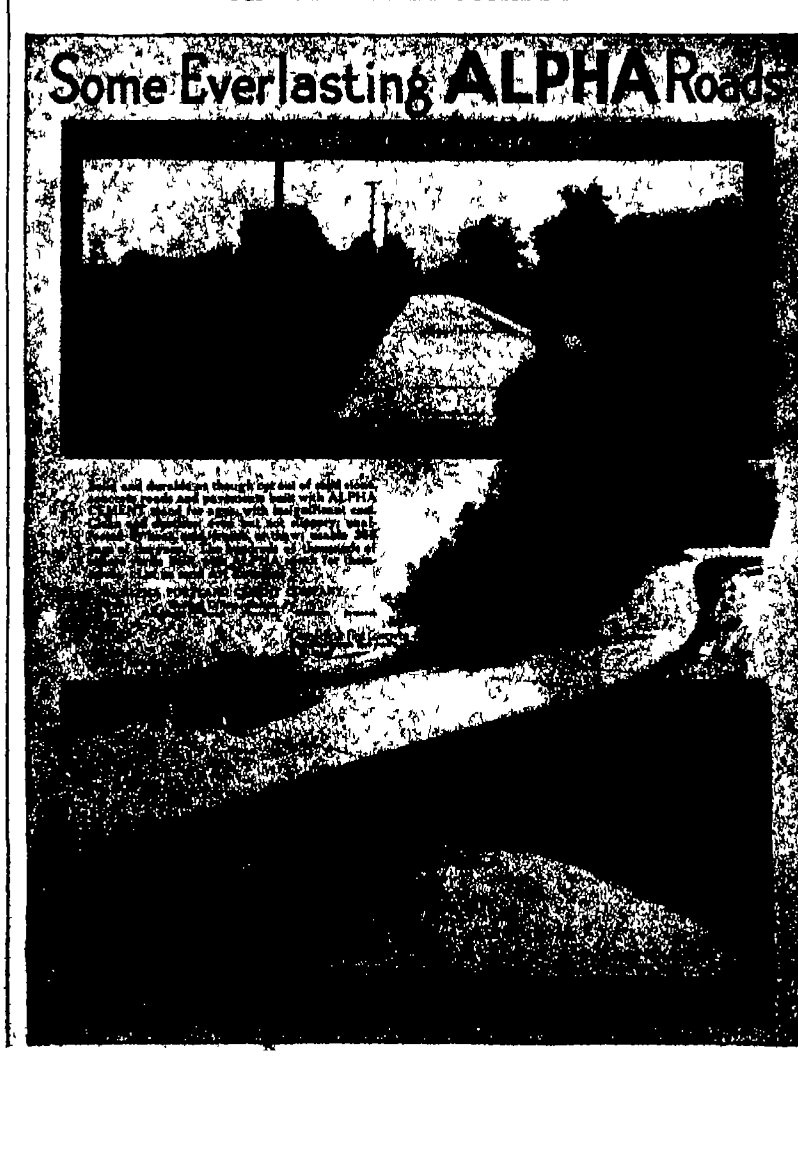
Air resistance is proportional to the density of the air, and if the density of the air is diminished the resistance of the air is proportionately reduced Due to great increase in muzzle velocities and to the reduction of the resistance of the air by improvement in the form of the projectile it is now possible with large angular elevations to throw the projectile to very great heights as it describes its trajectory The air as is well known becomes rarer as the height above the earth's surface increases. More than half of the entire atmosphere lies below a height of 4 miles and nine tenths of it within 10 miles Calculation shows that when in describing its trajectory a projectile ascends to a maximum height of 6 miles, the average air resistance in the trajectory is reduced one half, and that when the maximum height is 12 miles the average air resistance in the trajectory is only one fourth of what it is at the surface of the earth

For such an extreme trajectory as one with a maximum height of 12 miles the mean resistance is therefore only about one tenth part of what it would have been for a projectile of the old pattern shown in Fig 1 with a flat trajectory Modern construction has made possible a trajectory in which the resistance no longer precludes a close approach to the trajectory of unresisted motion.

The conditions of attainment of such ranges are exceptional; and for other elevations and lower velocities, such as are usual in practice, the range in air is seldom more than half of that for unresisted motion with the same elevation and initial velocity.

There are several reasons for not at-





tempting to realize in practice the full ranging possibilities referred to above. In the first place, what is called *erosion* is a great obstacle to the practical attainment of very high velocities Erosion consists in the wearing away of the rifling of the gun due to the great amount of heat and the high pressures inseparable from the attainment of great velocities Erosion is more troublesome in large guns than in small ones. Even with velocities in common use guns are often relined, or have the interior of the gun renewed, and this is a process which consumes time It is to be expected however, that science will eventually find a remedy or even a preventive for this troublesome disease of guns.

A second consideration limiting the practical ranges of guns lies in the fact that at sea and on the seacoast, where the largest and most powerful guns are used, the curvature of the earth actually hides the enemy at extreme ranges, such as those referred to above The scattering of the shots at such ranges would make the chance of hitting far less than one in a hundred.

Elevations of 30 deg with muzzle velocities of between 2 000 and 3,000 feet per second are, however consistent with present practice, the object being to at least equal the ranging power of the enemy

The bombardment of a distant city from a position on land would justify the employment of any gun at its maximum range. Here the target is sufficiently large to receive a majority of the shots. This explains the fall within the city of Dunquerque of shots fired from a point 21 miles away

Below are given the values of the curvature of the earth in feet for a number of different ranges

Range, miles	Curvature, feet.	Range, miles.	Curvature, feet.
5	17	30	600
10	67	35	817
15	150	40	1 067
20	267	45	1 350
25	417	50	1,667

Thus at 20 miles, it would be difficult to see even the top of a ship's mast from ordinary heights on shore and the ships would have the same difficulty in seeing their targets, whether the latter be ships or forts

That very great ranges in air are practicable for various velocities and projectiles may be seen from the following

Gun.	Ranges in miles.			
Velocity	2,600	2,800	3,000	3,200
10-inch	24	27	30	35
16-inch	27	31	37	43
Gun	Ranges in miles.			
Velocity	3,400	3,600	3,800	4,000
10 inch	40	47	54	63
16-inch	51	60	71	85

The greatest heights to which the projectiles ascend are

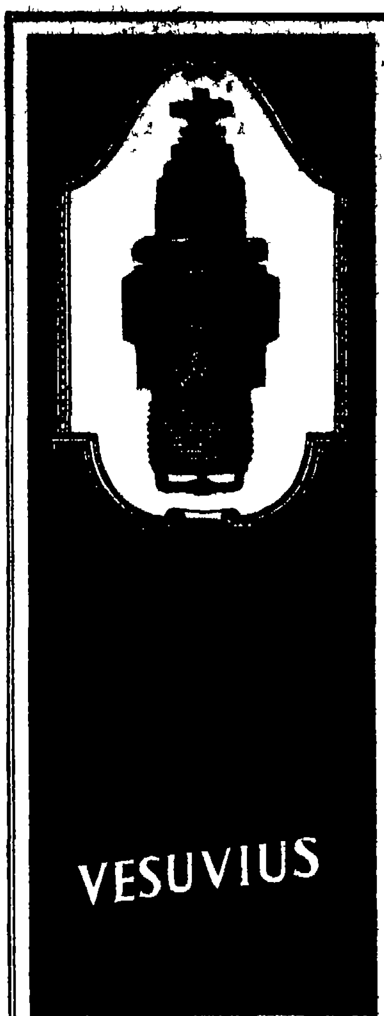
Gun	Heights in miles.			
Velocity	2,600	2 800	3,000	3,200
10-inch	7	8	10	12
16-inch	8	9	11	13
Gun	Heights in miles.			
Velocity	3 400	3 600	3 800	4,000
10 inch	14	16	18	20
16-inch	15	17	19	22

From these figures it is seen that firing 21 miles as from Nieuport into Dunquerque is feasible with a 10-inch gun with a projectile weighing 550 pounds and a muzzle velocity of 2,450 feet per second, while a 16-inch gun could perform the same feat, using a projectile weighing a ton, and with a muzzle velocity of only 2,250 feet per second These weights of projectile and muzzle velocities are in common use to-day, and the muzzle velocities are rather below than above the average requirements of the present.

In the same way it is seen that firing across the English Channel is entirely feasible, with a suitable gun and mount.

By the use of lighter projectiles, greater velocities are attainable in the same gun, and a range of 85 miles with an elevation of 45 deg is entirely possible with the most powerful guns in use in the world to-day

On the other hand, guns made for the mere purpose of attaining velocity and range and without regard to the continued effectiveness of the gun or the explosive power of the projectile, may attain almost any range within the limits of unresisted motion for the velocity used. Such guns would, at the present time, be



worn out by erosion, and the light projectiles would have small explosive effect.

The extreme ranges tabulated for trajectories in air are of interest not only as showing what is already *possible*, but as indicating that in future they may become practicable and usual. It is entirely possible that erosion may eventually be greatly reduced or even obviated, and indications are that the form of projectiles will be still further improved. The strides of the last half century in gun construction have been more remarkable than would be the steps now suggested as possible.

It is not extravagant, then, to assume that, at the proper time, these extreme ranges will be realized without undue sacrifice of the effectiveness of gun or projectile.

Conveying and Applying Concrete by Steam

(Concluded from page 379)

irregular. The small size of the tunnels would have made the use of ordinary forms inconvenient. Hand work would have been difficult because of the unevenness of the surface. Apprehensions were entertained even as to the steam method. It was thought that the heat and the exhaust steam would create difficulty in the small space. However, a steam boiler was brought into use on the surface and the combined mixer atomizer added to the surface equipment. A rubber hose conveyed the concrete down into the tunnel and to the point of use. No especial difficulty developed and the work was successfully carried out, the distance of transmission running up at times to several hundred feet. The same railroad has used the steam method in repairing disintegrated places on concrete retaining walls. The chisel was employed to clear away defective concrete. No trouble was experienced in *putting concrete onto these vertical surfaces*. Here we have what appears to be a very considerable advantage. Forms may often be dispensed with in vertical work and even in overhead applications. The New York Central Railway utilized this procedure quite recently in giving a white coating to certain parts of the concrete substructure of the great Grand Central Terminal in New York City. Here it was not a question of concrete but a Portland cement mortar consisting of one part cement and three parts crushed marble. The mortar was sprayed on in two or more coatings of about ⅛ inch each.

A more considerable piece of work was done by the Chicago and Great Western Railway in the restoration of an old tunnel half a mile long. The bore passes through rather unstable material containing more or less water. Originally wooden timbering had been used. Later on a brick lining was put in place inside of this. The cross section available for use was in this way cut down to just about the limit. A great deal of disintegration took place with the passage of time, this disintegration arising in part from freezing and thawing. In short, it became imperative to restore the stability of the construction, especially in the roof. It was highly desirable too not to take the tunnel out of service. All the conditions conspired to make this a most difficult problem.

The steam method was applied, but this time upon a movable construction train which could be run in and out of the tunnel at a moment's notice. A flat car just back of the tender provided for the machine. Steam came from the locomotive. The transmission line was carried back onto a second car. Here a platform 20 feet long and 4 feet high supported a track on which a carriage could be shifted a distance of 10 feet by a hand-operated windlass and rope. On the carriage a nozzle holder was set up. This was movable in such way that the nozzle could be swung through an arc lying in a transverse plane. The holder was swung by means of a small steam engine. The transmission line was flexibly connected with the nozzle. There was a box car to the rear which was utilized to support a platform and railing for the men cleaning the surface preparatory to the application of the concrete. The whole train could readily be shifted by the locomotive, the nozzle longitudinally by the windlass and

the nozzle laterally by the little steam engine. One setting of the train permitted application of concrete to some 100 square feet of surface. The concrete was made on the formula 1 3 2, the coarse aggregate consisting of pebbles.

When spraying begins, some of the coarser material will not adhere, the layer of cement being at the moment insufficient in thickness. But these coarser pieces are thought to perform a very useful service by battering the finer material into the surface As the coating gets thicker, larger and larger pieces adhere. Those which fall off may be recovered and used again

Wood Waste

(Concluded from page 383)

inches square, often larger All were sold as kindling from the plant at, perhaps, one sixth of the cost price, or used in the plant itself as a fuel, whose value was from one third to one half that of low grade bituminous. It has been carefully proved that wood waste in the wood-using plant is seldom less than 19 per cent of all material purchased, it is often as high as 30 per cent. But in the factory, wood waste, for most practical purposes, stops. Indeed, there is little more to waste, though in different parts of the country there are some special wastes—as in the early turpentine orchards, where improper "boxing" is said to have ruined for commercial purposes one fifth of the forests worked, and the tanbark operations which continued for many years in hemlock, operations where the bark was all carefully peeled and taken, and the trees were left

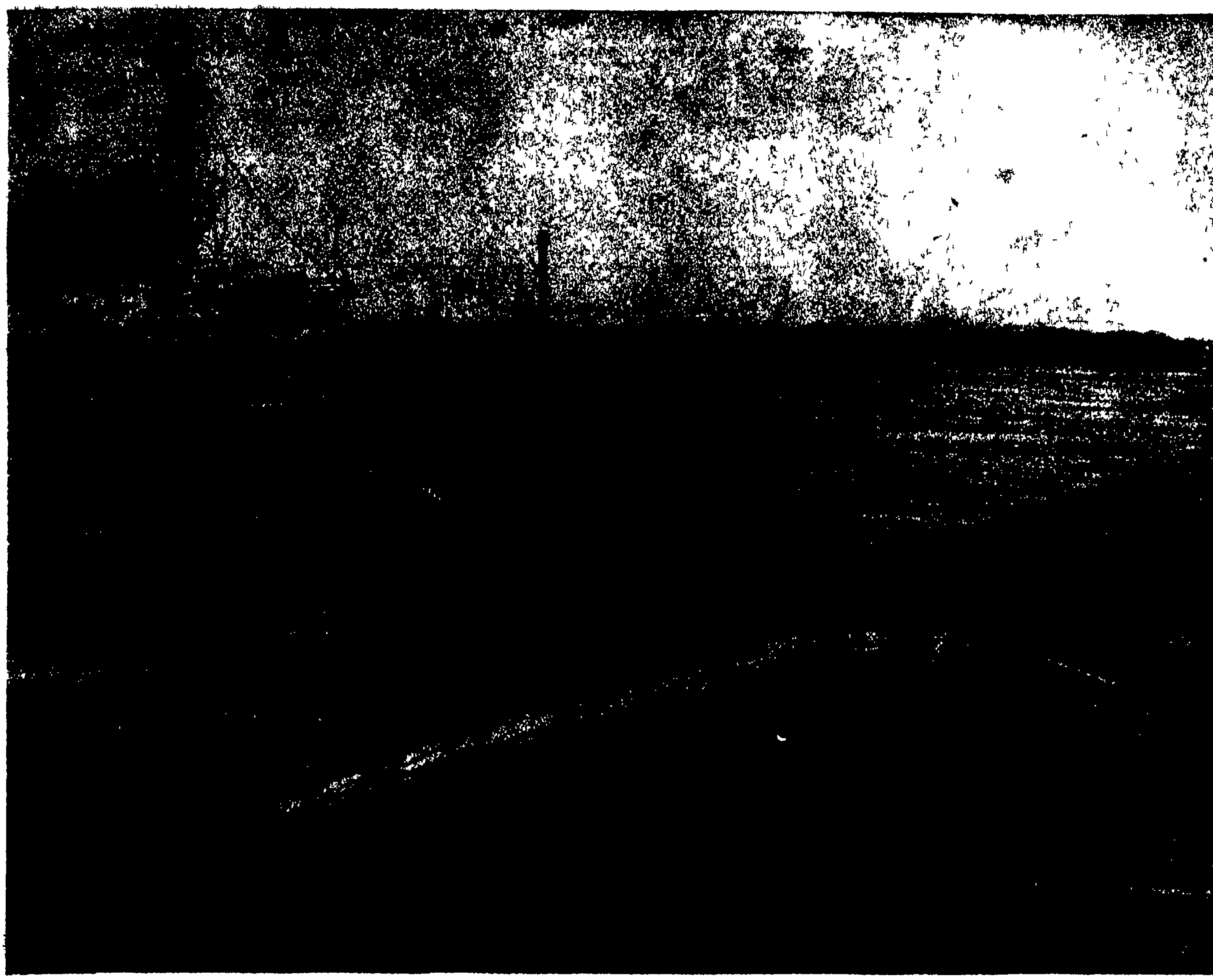
Waste as a Whole, and Its Effect

Wood left in the forest, from branches, tops, chips, stumps, and sawdust, was fully one third of the tree, the mill took one third of the log as sawdust slabs, and trimmings, the factory one fifth of the board as sawdust, seasoning, shavings, edgings, and defects. Practically 35 per cent of the tree will appear in the finished product. This proportion may vary with States, it does not differ much for the country

We could better afford it if this were all, but in the forests where this material had its source, there is, perhaps, no provision for another crop, at best, one markedly inferior The land, if in the hills or mountains, is probably abandoned with little effort toward its improvement through cultivation The cost of floods has never been really worked out, though now and then, as recently in Illinois, cames an account of one which does a million dollars' estimated damage, destroys railroads and buildings, a few lives, and inundates perhaps a hundred thousand acres of rich farm land Probably $50,000 000 to $75,000,000 is being lost to this country annually through the poor use or absolute disuse of millions of acres of cut-over lands profitable only for the growing of trees There are now some 16 600 square miles of land, 0 6 per cent of the country's total area, once fertile enough, but at present in abandoned farms, 6,100 square miles of which, after unskillful cultivation and final abandonment, had further to be ruined through soil erosion

The wastes of factory and mill affect us most directly in a financial sense, those of the forest, so long as forests are reckoned an attribute of successful national management and welfare, must be long reaching in their benefits or injuries. Small blame attaches to the lumberman. He has been an instrument throughout of trade necessities and economic situations.

Lights His Pipe Electrically — William H Fulton, of New York city, in a patent 1157771, describes the defects in the ordinary tobacco smoking pipe resulting from the distillation of the moisture on account of the air being drawn down through the unburnt portion of the tobacco and claims this will be avoided by igniting the tobacco initially at the bottom of the bowl. To do this he provides at the base of the pipe bowl an electric conductor which is energized by a [illegible] connected up to an electric lamp socket so that as the pipe is being lighted the lamp filament will glow to indicate when the tobacco lighting conductor is operating.



He Invented the Periscope—A Fortune Was His—Then—

What all the naval experts of the world could not devise, this "rolling stone" invented. Then, though his invention was a success, though no one else had attempted such a device, Fate stepped in to rob him of it. His dream of wealth was shattered!

MORGAN ROBERTSON proved that truth was far stranger than fiction when he wrote for the Saturday Evening Post the story of his own life. Take, for instance, his inventive side. No one has written a romance of industry that compares with Robertson's experiences in inventing the periscope.

Robertson had gone to visit a naval officer, to secure material for a sea-story The officer took him on board a submarine.

Let the sailor-author continue the story·

"While in the lower part of the little boat the lieutenant in command showed me all its workings. It was a great day for me.

"'The one thing we need,' he said as we came up, 'is an apparatus by which we can see what is going on above without having to rise.'

"'In other words,' I added, 'if you could look into a glass down below, and, by a series of reflections, be able to view the surrounding surface of the water above, it would then make the submarine the most powerful of battle ships.'

"'Exactly'

"'Then I am going to invent it,' I declared, and I left him, knowing absolutely that it could be done.

'At that very moment, though I did not know it, a Frenchman, seated at his desk in Paris, was innocently devising a fantastic yarn that was destined to deal me a crushing blow—from which I never recovered.

"It was at the expiration of a year of experimenting I suddenly discovered that, in addition to other lenses, a cone-shaped glass placed in the end of the tube would do the trick of refracting the light rays as I wanted them I was beside myself with joy Working night and day I quickly rigged out a model, and—imagine my delight, it worked! I had solved the problem! I had invented the periscope!

"I sat across the desk from the lieutenant as he unrolled my blue-prints, and I shall never forget the expression in his eyes when he looked at the first one

"'You've got it! he declared exultantly 'The cone-shaped tip solves the problem I congratulate you.'

"I told him I had applied for a patent.

"The lieutenant suggested to me that if I could live on fifty dollars a week his company would put me on the payroll so that I might continue my experiments

"It was in the midst of these happy moments that the blow fell And this brings me back to the Frenchman and his yarn

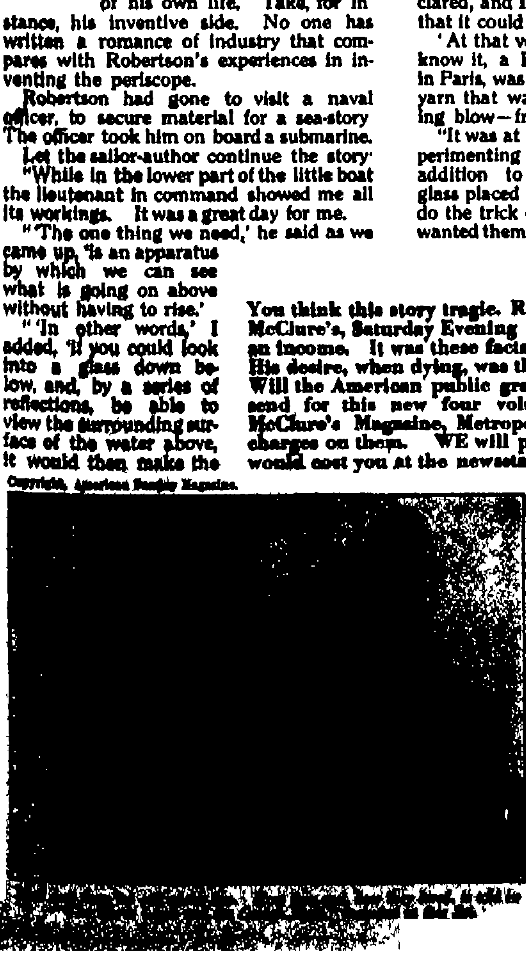
'The lawyers notified me that the United States Government had refused to grant me a patent on the periscope because a story had been published, prior to my application in a French magazine, which had described fantastically the possibilities of an instrument similar to the one I had invented

My hopes were blasted Understand this Frenchman did not attempt an invention He merely wrote that it was possible

'My beloved periscope was now public property, and anybody had the right to proceed with its development Though the submarine boat people had treated me generously, my devices were no longer needed I was out of a job Really I believe it was the saddest moment of my life when I went back to the typewriter and began to lay out a story Ahead of me I saw the old grind the weary rounds of the magazine offices the butcher the grocer, the landlord and the wolf!'

MAKING A DREAM COME TRUE

You think this story tragic. Robertson's life was full of such tragedies. Though he wrote stories that such magazines as McClure's, Saturday Evening Post, Harper's, etc., eagerly accepted, he died poor, and left his frail little wife without an income. It was these facts that led to the McClure-Metropolitan movement to gain him recognition and reward His desire, when dying, was that the sale of his books would permit his devoted wife to live without want. Will the American public grant him his last wish? That's what we propose to find out. YOU answer YES when you send for this new four volume edition of Morgan Robertson's Works, together with a year's subscription to McClure's Magazine, Metropolitan, and The Ladies' World. WE will pay for the books. WE will pay the carriage charges on them. WE will pay Mrs. Robertson a generous royalty—if you will pay for the magazines less than they would cost you at the newsstands, and you may pay for your subscriptions in easy monthly payments.



This HANDSOME 4-VOLUME SET FREE

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The Morgan Robertson stories, embracing his best work, are in four handsome cloth bound volumes—1,000 pages—over 300 000 words printed in new easy to-read type—titles stamped in gold. You send only ten cents with the coupon After that, one dollar for four months to pay for the magazines, twelve months each at less than retail prices, and that's all! The books are yours FREE. If you wish to pay all at once, send only $3.75. If you prefer full leather binding, send $5.75. Magazines may be sent to different addresses. If you are at present a subscriber to either magazine, your subscription will be extended.

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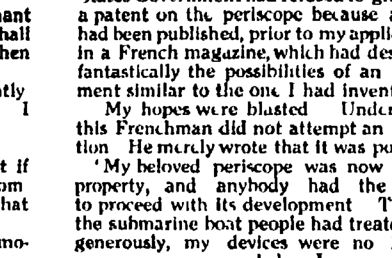

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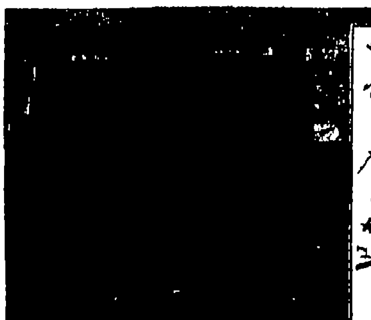
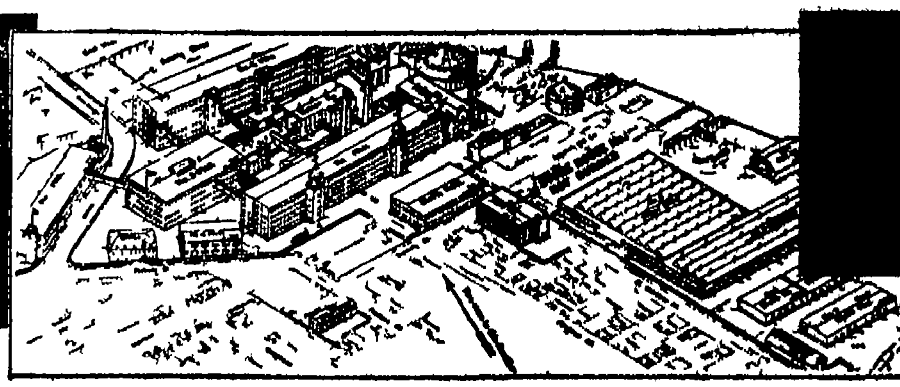




Salem Mass, fire June 25 1914 Map showing plant of Naumkeag Steam Cotton Co which was entirely destroyed with the exception of Storehouse No a reinforced concrete building, and Storehouse No. 10 The picture on the left shows Storehouse No 1 su ounded by the ruins of othe buildings On the right upper the interior with contents unharmed lower wired glass window melted by the heat and interior shutter scorched by flames.

Concrete Buildings Protect Against Fire

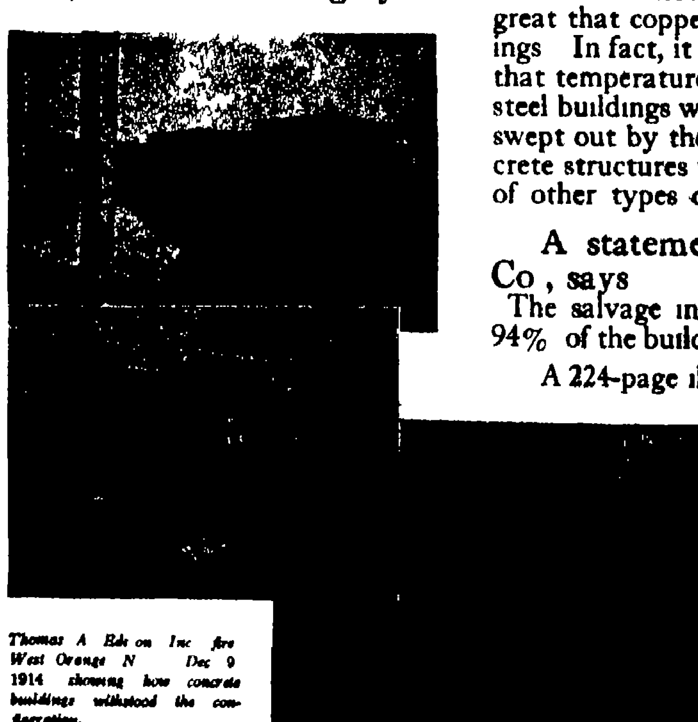
WHEN the great Salem, Mass., fire destroyed in thirteen hours sixteen hundred buildings, valued at over fourteen millions of dollars, the destruction of the great plant of The Naumkeag Steam Cotton Company was the heaviest individual loss. Of all the buildings of this enormous plant only two escaped destruction, and of these Storehouse No 1, which was in the direct path of the flames, was practically uninjured.

In a complete report of the disaster issued by the National Fire Protection Association, Boston, Mass., President Franklin H. Wentworth says:

> The only buildings in the entire plant that escaped destruction were No 10 Storehouse and No 1 Storehouse No 1 Storehouse is of reinforced concrete construction, walls, roof and floors There are some small wired glass windows in metal sash, mostly fixed, which are protected in addition by wood tin-clad shutters on the inside of the building, hinged at the top and swinging vertically, and these were held open normally by fusible links These links all melted and allowed the shutters to close Two stories of this building contained finished goods in cases, but although the building was exposed to the full force of the conflagration on the west side, so completely did the window protection do its work, and so well did concrete walls stand up against the flame that fire did not enter the building Not a sprinkler opened and the contents are intact The damage to the building is so slight as to be almost negligible, and while the wired glass windows in several cases suffered so much heat that they softened and bulged out at places and in one case completely melted out, yet the interior shutters withstood the attack, and did not allow the fire to enter the building

THOMAS A EDISON said: "*All permanent buildings which I shall erect in the future will be built of concrete, as the results of our fire are a triumph for this material.*"

The burning of the Edison plant at Orange, New Jersey, Dec. 9, 1914, offers again a remarkable testimonial to the fire-resisting qualities of concrete Due to the tons of celluloid, wax, lumber and other highly inflammable materials in the buildings the intensity of the fire was so great that copper melted iron fused, and the glass melted from the window openings In fact, it was estimated by a committee of men of high professional standing that temperatures in excess of 2500 degrees F were reached Six wood, brick and steel buildings were entirely destroyed and the contents of seven concrete buildings swept out by the flames But when the fire had finally spent itself the seven concrete structures with walls and floor slabs intact, stood amid the ruins of buildings of other types of construction



Thomas A Edison Inc fire West Orange N Dec 9 1914 showing how concrete buildings withstood the conflagration.

A statement made by the officers of the Thomas A. Edison Co, says

"The salvage in machinery in the reinforced concrete buildings will be at least 94% of the buildings 87% cost of restoration of these buildings from 10% to 15%"

A 224-page illustrated book—"Factories and Warehouses of Concrete"—will be sent free of charge to prospective builders of factories and warehouses who write to us on their letterheads We will also send on request a copy of an authoritative report on the Edison fire

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THE WAR GAME—V

SCIENTIFIC AMERICAN

RUSSIAN INFANTRY MAKING USE OF MOVABLE STEEL SHIELDS DURING AN ATTACK [See page 407]

April 15, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV.] NUMBER 16 NEW YORK, APRIL 15, 1916 [10 CENTS A COPY $3.00 A YEAR

By carrying the torpedoes in a revolving cradle, back of the torpedo tube it is possible to fire several torpedoes in rapid succession while the submarine is bearing on the enemy

THE "REVOLVER" TORPEDO TUBE FOR SUBMARINES

The Rapid-fire, "Revolver" Principle Applied to the Submarine Torpedo Tube

By Edwin Cerio, Naval Architect

CONSIDERING the limitations of space which con front the submarine designer, it is only natural that the practice of increasing the number of torpedo tubes should have resulted in the adoption of an additional armament *fitted to the out side hull of submersibles*, thus obtaining a combined armament of inner and outer tubes of very doubtful efficiency

The basic difficulty of increased of fensive power of vessels in which limited dimensions and compactness are of para mount importance and essential for their handling, can only be adjusted by concen trating the torpedo armament *within the water-tight hull* in order that the arma ment may be easily controlled and speedily operated during the few instants upon which a submarine may reckon to de liver, successfully, a torpedo-attack.

Torpedo-tubes are the sole reason for the existence of the submarine, but their efficiency is entirely dependent upon a primary tactical condition: the possibility of firing torpedoes in a given position.

Owing to the limited field of vision and reduced under-water speed, the attacking position of a submerged submarine must be pre-established when the boat is run ning on the surface and maintained while diving. It is thus evident that only the torpedo-tubes bearing in the direction in which the attack has been prepared during surface navigation, have a chance of delivering a successful blow. It was only due to an error—which was emphasized by the British Admiralty's report on the sinking of the "Hogue," the "[illegible]" and the "[illegible]"—that the [illegible] U-9 [illegible] in [illegible] the remark- [illegible] [illegible] and maneuvering under water so successfully as to hit three targets with four torpedoes. With the exception of this performance all successful submarines' attacks per formed during the present war confirm the tactical theory, based on the speed and vision limitation in herent to submarine warfare and this will no doubt direct naval thought towards a more satisfactory solu tion of the torpedo-armament problem in the near future

In attempting such a solution the features of tor pedo armament which need be considered are the following

1 The efficiency of torpedo armament depends upon the number of torpedoes which can be discharged in rapid succession by a submarine running under water on the course pre-established during sur face navigation and followed when diving

2 The primary offensive virtue of sub marines depends upon the number of blows which can be delivered in the shortest period of time in a given direc tion and not upon the number of torpedo-tubes from which torpedoes *might* be fired if the vessel could be handled in order to alter its course and change rapidly from one advantageous tactical position to other successive favorable at tacking positions The latter is the case with modern destroyers and justifies the ample provision of torpedo tubes dis tributed forward aft and amidships but not with under water craft

3 As the high speed and the resulting tactical superiority of destroyers justify a wide distribution of torpedo armament throughout the ship's length the low speed and tactical limitations of the sub marine emphasize the advantage which results from concentrating all offensive power forward and within the water tight hull of the boat

If these conditions are considered, sub-marine designers will find the engineering problem of fighting efficiency outlined by the military features which torpedo arma ment must embody

An attempt to solve this problem under the conditions stated above has been made by a revolving torpedo magazine and dis charging device illustrated by figures 1, 2 and 3.

As the figures show, the forward end

(Concluded on page 409)

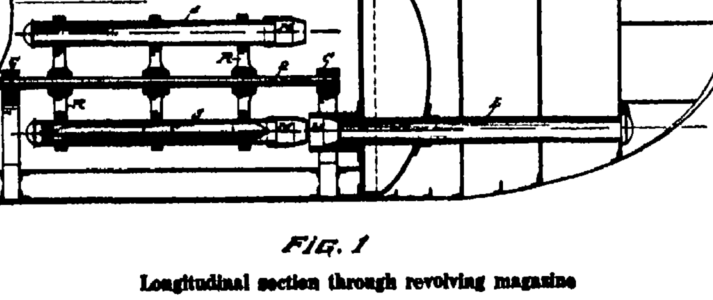

FIG. 1

Longitudinal section through revolving magazine

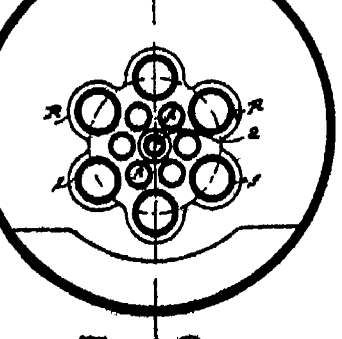

FIG. 2

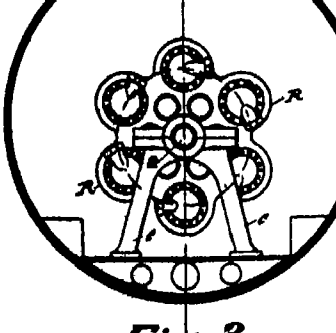

FIG. 3

Cross-section showing details of revolving magazine

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Militarism and the Militia

IN our issue of April first we discussed the army bills before Congress and the probable effect, good and bad, of their several provisions. Particular effort was made to invite attention to the clauses affecting the militia and to the danger of creating a political organization in each state, under the immediate command of the governor which organization, unified by military discipline and constantly increasing in numbers by reason of federal pay would soon be in position to exert compelling influence upon members of Congress.

That our fears in this respect are shared by those who have opposed this legislation is proved by the minority report of the House Military Committee on this same proposition in 1912. In that report it was stated that "this course will surely lead to the creation of a great military force so powerful politically that Congress will be no more able to resist its demands than it has been to resist the demands of the far less compactly organized army of pension applicants." (Report 1117, Part II 62d Congress, 3d Session.) Some of those who submitted that report are still members of the committee. On April third Senator Chamberlain, on the floor of the Senate, publicly complained of the influence the militia lobby was exerting to obtain greater concessions than his committee had deemed wise, "and we are already stepping upon the heels of the Constitution," he added.

The passage of the bill in the House, with the defeat of every amendment looking toward a better regular army and toward the creation of a truly federal citizen force showed that constructive military legislation could not be expected from that body. It was hoped however, that the Senate would save the situation. But in the debates it soon became evident that Senator Chamberlain's statement as to the militia lobby was justified. One of the first amendments proposed was to authorize the appointment of five officers of the National Guard (militia) as members of the General Staff of the Army.

The General Staff was born in the Senate, and around the appointment of its members was thrown the safeguard of "such special rules of selection as the President may prescribe." These rules require that officers shall be detailed as members of that corps only on recommendation of a board of five general officers of the Army, all sworn to make such recommendation solely on the basis of proven professional efficiency and probable aptitude for the important duties delegated to the General Staff. These general officers have not only a personal knowledge of the character and ability of their subordinates but have access to the records of all officers' service day by day for periods of from fifteen to twenty five years, including the confidential opinion of each immediate commanding officer.

It may be seen that, though a mistake in selection may be made, nevertheless the chance thereof has been reduced to a minimum. And now the very legislative body which, in its wisdom, insured the General Staff of the Army being so carefully selected, has passed an amendment authorizing five militiamen to be appointed thereto. Not one of the safeguards can be made to apply. There is no exhaustive record of these militia officers' lives, nor can we ever hope to have such a record. And it is not possible for militia officers to have the experience and training heretofore considered an essential for a general staff officer of any army.

The effect of five votes in a small body can be appreciated by any who have been members of a board of directors of any large business. Certainly any member of Congress who has served on a committee cannot fail to appreciate it.

It was stated in our issue of April first that the proposed legislation threatened to turn over the nation's defense to state-controlled troops. It was thought then that the General Staff would be the last corps of the Army to be invaded. That it has been the first indicates the gravity of the danger.

Simultaneously with this action in the Senate there has come to our attention a circular letter of the National Guard Association of New York which proves beyond peradventure of doubt the existence of an all powerful lobby of militiamen in Washington. In that letter militiamen are informed that, while the Hay Bill is not all that could be desired, it was "felt by the *National Guardsmen in Washington* that it would be better not to raise any issue as to that bill, but to *concentrate against the Senate Bill* which cuts out pay for militia officers above the grade of captain." Throughout this letter there is no evidence of any interest in national defense. Special consideration for the militia is its guiding impulse, concerted effort to bring pressure upon Congress to that end being urged.

The present progress of the militia propaganda, if it be indicative of the future, points plainly to increasing demands with increasing power. No thinking man can doubt that the political force so dreaded by the Democratic minority in 1912 has already become formidable. Secretary Garrison opposed it and was forced to resign from the cabinet. Another year may see the militia representation on the General Staff doubled or trebled and the pay of the state troops still further increased. And when the full six hundred members in each congressional district have been enrolled and organized, we may see the election or re-election of any Congressman entirely dependent upon his attitude toward militia preferment and pay.

The Constitutional safeguards around the Regular Army can have no application to this new army. The Regular can rarely vote—he can never hold office. The members of this new force can and will do both. Unless some strong action is taken to check this movement in its incipiency the strongest assurance for the continuance of a truly representative government in these United States will be lost, and militarism, which may be defined as the existence of a military force which exerts a political influence insuring for its members special consideration under the laws, will be ours before we know it. And so the menace of a great standing army so dreaded by our fathers, will be an accomplished fact.

Sea-Going Submarines and their Torpedo Armament

UNAPPROPRIATE or imperfect definitions of certain classes of war vessels, notably of torpedo craft, have often caused confusion as to their real purpose and actual calling in naval warfare. Such, for instance, has been the case with the destroyer, which, through the many stages of its evolutions, has retained a descriptive denomination implying the destruction of torpedo boats, whereas the essential purpose of the latest specimens of such craft has become the destruction of line-of-battle ships. Similar confusion has arisen in defining the present day submarine and that which shall be the submarine of to-morrow: the type of boat of large displacement and high surface speed combined with a strong armament and highly developed sea going qualities. The "fleet" or "squadron" submarine, as this type is generally referred to, as opposed to the coast-defense and the mosquito craft, is a conception, or, rather, a misconception, derived from an obsolete utopian idea: the French *submersible d'escadre*. With the advent of the internal-combustion engine French naval constructors and other authorities who followed the French lead had hoped to increase the surface speed and other tactical qualities of submarines to a degree that would have permitted their employment in the line of battle.

The hope of developing the submarine into a weapon capable of being employed as a fleet unit—to perform, in daylight, the work which falls to the lot of the destroyer at night—might well have been entertained in the ante-dreadnought era, at a time, that is, when valve gear and superheated steam seemed to have marked the last stage of progress of steam propelled vessels and the great increases of speed which armored ships have attained through the adoption of the steam turbine were yet undreamed of. In naval warfare, tactical qualities and, above all, speed, have a purely relative value, and if the relative speeds of to-day's battleships and submersibles are considered, all hopes of realizing the fleet submarine must be given up or postponed to the remote future, in which the speed-problem of submarines may be solved by the advent of the single motor for surface and submerged navigation.

The outstanding feature of submarine warfare, *i. e.*, an inferior speed to that of its objective—the battleship—the absence of protection on the surface and the proportion of offensive power to displacement, all combine to indicate that, tactically, submarines either offensive or defensive [illegible] pendent of armored [illegible].

The purely [illegible] realized and it represents an [illegible] and harbor defense. Between this type, which is yesterday's reality, and the "fleet submarine," which is to-morrow's dream, there is room for a conception embodying all requirements of present day [illegible] warfare, the sea-going, sea-worthy diving boat of 1,000 or 1,200 tons, powerfully armed, of high surface speed—20 to 22 knots—and great fuel radius—3,000 to 3,500 miles—capable of attacking battleships and destroying commerce on the high seas.

This class of vessel, better referred to as the sea or ocean going submarine than the fleet submarine, with scarcely any increase in tonnage over that which has already been attained (1,200 tons), if more efficiently armed than the present day diving boats, would find a wide field for action in naval war.

Maneuvers carried out in time of peace by the principal navies to ascertain the tactical value of submarines since 1909, and the actual war practice in which such craft have been engaged these last two years, have directed naval thought to the shortcomings of submarines, but, at the same time, have pointed out the path on which further improvements of this redoubtable weapon might be realized.

Such remarkable and exceptional feats as the performance of U 9 on September 28, 1914, which succeeded in sinking three armored units, or that of the British E-9 at Heligoland, do not lend themselves to generalization, though they indicate the degree of efficiency which might be attained by all submerged vessels operating under favorable tactical conditions. These instances and other numerous feats performed by submarines operating independently of armored squadrons have reopened the much-debated question of torpedo-armament and its proper proportion to the other elements which combine to make fighting efficiency.

Up to the present the only attempt made to increase torpedo-armament has consisted in increasing the number of torpedo tubes. This number, which was 2 or 4 in the coastal submarines of a few years ago, has gradually reached 6 and 8 in recent designs, and even 10 in the case of the French "Diane" class. Obviously, the ideal arrangement of the torpedo tubes would be one that permitted all of the torpedoes to be fired in rapid succession while the submarine was bearing on the enemy, and as a solution by an Italian naval architect of this problem, we direct attention to the article by Edwin Cerio on another page.

A Seeming Parodox

THE more you put into a patent claim, the less it covers.

Many applicants for patents and many patentees complain that their claims do not fully describe their inventions, in that certain features of construction appearing in the drawings and described in the specifications have been omitted from the claims, and it takes a lot of explaining to make them understand that these things were intentionally left out of their claims in order that their invention shall be fully protected.

Courts must take the claims of a patent as they stand. They will add nothing thereto, nor omit anything there from. Therefore, if a claim is loaded up with unessential details, such a claim is a limited claim, and nothing that does not embody every detail specified in the claim, or the full mechanical equivalent therefor, will infringe such a claim.

Thus, if an invention consists in bringing together for the first time a wire basket, a handle, and a cover for the basket, forming a corn popper, and the model submitted should show the cover for the basket as being hinged at one end and closed automatically by a spring, a properly drawn broad claim for such an invention would omit to describe the cover as made of wire, or that it was hinged at one end to the basket, or that it was closed by a spring. If such features were added to the claim, it would make it a relatively narrow claim and one that would not be infringed by another corn popper which did not embody all the features specified. And, assuming that the patentee was the first to produce a corn popper comprising a wire basket, a handle and a cover, his patent, if it contained only such detail claims would not afford him that protection to which he was entitled.

All of which shows how important it is to have patent claims properly drawn, for as laid down by the Courts, the claim is the measure of protection afforded by the patent, and the patentee is absolutely bound thereby.

Properly prepared patents and carefully [illegible] claims not only afford full protection [illegible] but if litigation [illegible] in the effort to stop infringers, much of [illegible] of attorneys and the Courts is saved, [illegible] litigation.

Naval and Military Notes

Tramp Steamer Record in the Mediterranean.—The French squadron operating in the Mediterranean has to coal and ship stores at sea from improvised mother-ships coming from Toulon. J. B. Gautreau, writing in the *Naval and Military Record*, says that one of these slow tramp steamers recently had a record of 19 voyages, during which it had supplied to the fleet 90,000 tons of coal, 20,000 tons of water, and 6,500 head of cattle, and this in spite of the fact that it was operating in submarine-infested waters.

Naval Personnel on a War Footing.—When war broke out, there were 146,000 officers and men in service in the British Navy. In addition to these were 67,000 reserves. At the end of January, there were in active service 320,000 officers and men. Parliament had authorized the Navy to work up to a maximum of 350,000 officers, men and boys by March 31st, 1916. Back of these, engaged on ship construction, repairs, etc., are about 700,000 men, making a total force working for the Navy ashore and afloat, of over 1,000,000 men.

The Age Question in the French Navy.—Evidently the United States Navy is not the only one which is troubled by the problem of promotion in relation to age, for we are informed that the French officers are older than in any other navy, Vice-Admirals being, on an average, appointed at the age of 61, as against 52 in England, Rear Admirals at 56 as against 47 in England and the French Captains and Commanders being as a rule older than British Flag officers. Under the new scheme, the age limits are to be brought down approximately to what they are in England. We should do the same in the United States.

The 17-Inch Naval Gun.—The largest naval gun in commission on a warship is the 15-inch piece mounted on the "Queen Elizabeth" and her class. Next in size is the 14-inch gun mounted in our own and the Japanese navy. The largest gun reliably known to be mounted in the German navy is the 12-inch piece. However, among the many rumors regarding the German naval developments is one to the effect that a 17-inch naval gun is being mounted on the latest German battleships. The story that earlier ships are being armed with a 17-inch gun may be set down as a canard—the thing simply cannot be done. The big gun movement is active and will persist for some time. Possibly the 16-inch gun will be adopted for our future dreadnoughts.

Warship-Building Capacity of Germany.—According to that excellent naval critic Hector C. Bywater, so far as building ways and construction plants are concerned, there is no reason why Germany could not have 25 battleships or battle-cruisers under construction at one and the same time. Though he admits that this figure may be astonishing, he shows that an examination of the various yards Governmental and private, in Germany, justifies the estimate. In fact, he goes further, and states that, simultaneously, a program including light cruisers, destroyers and submarines, could be put through since there are many German yards which, although they cannot build capital ships, are well equipped to produce the lighter craft. He estimates the total working force in all these yards at 100,000 men.

Gun Construction Capacity of Germany.—It is well understood among naval men that the limiting element in the question of rapid construction of a navy is the speed with which the guns and armor can be produced. Speaking upon this question, Mr. Bywater draws attention to the fact that during the naval agitation of 1909 in England, the then First Lord, Mr. McKenna, stated that it was not beyond the power of the Krupp establishment to produce all the guns and armor necessary for eight dreadnoughts per year. This output would be additional to the enormous home and foreign orders for war material taken care of at Essen. Hence having in view the increased size of the Krupp works this authority believes that the Essen and affiliated factories could supply the guns and armor for all the dreadnoughts and other ships which Germany is capable of building.

Ships Lost By Allies and Neutrals.—The most reliable statement of the total losses in merchant vessels, both steam and sail, is that recently made by Admiral Sir Cyprian Bridge. His report gives the total losses from the beginning of the war to March 23rd. The Allies have lost a total of 588 ships of an aggregate tonnage of 1,668,000. Great Britain heads the list with 410 ships, of 1,880,000 tons, France being second with 68 ships, of 158,000 tons, followed by Italy with 27 ships of 78,000 tons, Russia with 85 ships of a total of 49,000 tons, Belgium with 10 ships, of 30,000 tons, and Japan with 3 ships of 19,000 tons. Very surprising in their magnitude are the losses of neutrals, which total 218 ships, with a total tonnage of 398,151 tons. The British loss in steam shipping is less than 4 per cent of the total number of vessels, and a [illegible] over 6 per cent of her total tonnage. The French [illegible] 7 per cent, the Russians 5 per cent, and the Ita[illegible] 4.5 per cent.

Astronomy

A Great Meteorite Found in Brazil.—A meteorite weighing about 20 tons is reported to have fallen recently at Beserros, in the state of Pernambuco, Brazil.

The Solar Eclipse of 1918.—Astronomers are already beginning to make plans for observing the total eclipse of the sun which will occur June 8th, 1918. The path of totality extends diagonally across the whole United States, as the shadow, after crossing the North Pacific Ocean, will enter the country in the neighborhood of Chehalis, Washington, pass over Baker City, Oregon, Hailey and Montpelier, Idaho, Rock Springs, Wyoming, Steamboat Springs, Central City, Golden and Denver, Colorado, Lakin and Ashland, Kansas, Enid, Oklahoma, Jackson, Mississippi, and Orlando, Florida. Along the easterly part of the route the sun will be too near setting for the best observations.

Studies of a Star Cluster.—The Mount Wilson Solar Observatory has completed a catalogue of the magnitudes and colors of more than a thousand stars in the globular cluster Messier 13. Nearly 11 per cent of these stars have negative color indices, suggesting that in this direction there is no marked absorption of light in space. Of the 400 brightest stars, 70 per cent are redder than a normal solar type star; of the 400 faintest, 85 per cent are bluer than the normal solar type star. By statistical methods the parallax of the cluster has been found to be less than 0.0001 second of arc. Five new variables have been discovered in this cluster, making a total of seven.

French and German Astronomical Journals in Wartime.—Considerable turmoil has been stirred up in the ranks of the Astronomical Society of France by the action of a former member, a Swiss named Weibel, who recently resigned from the society, giving as his reason the fact that he "had enough of this abominable war, or rather butchery, in the daily press, and when he sought recreation in the study of astronomy he did not wish to read more articles on the same subject." This criticism had reference to the monthly journal of the society *L'Astronomie*, which has delivered one onslaught after another upon the Germans, including the German astronomers, ever since the war began. Herr (or Monsieur?) Weibel proceeded to say that he much preferred reading the German astronomical journal *Sirius*, in which he had never seen a single word about the war. Needless to say, his resignation was promptly accepted.

Stellar Radiation and Star Colors.—The remarkable measurements of the radiation of stars made by Dr. Coblentz, of the Bureau of Standards, with his new thermo-electric apparatus in connection with the Crossley reflector at the Lick Observatory have brought out an interesting relationship between total radiation and optical brightness. It appears that the eye is a poor judge of stellar radiation. For example in the "Dipper" the yellow star Alpha, one of the "pointers," is somewhat fainter to the eye than the blue star Epsilon in the handle, yet the total radiation emitted by the former is nearly twice as great as that of the latter. It is found that in general red stars emit two or three times as much total radiation as blue stars of the same photometric magnitude. Measurements of stellar radiation transmitted through an absorption cell of water reveal the fact that in the spectral region to which the eye is sensitive blue stars have about twice as much radiation as yellow stars and three times as much as red stars.

Dark Nebulae.—A recent paper by Prof. E. E. Barnard, in the *Astrophysical Journal*, gives strong support to the belief that, just as there are probably many dark stars—more, perhaps, than bright stars—so there are many dark nebulæ. Dark stars are necessarily invisible, and reveal their presence only by their perturbing effect on the motions of bright stars and by eclipsing their light. Dark nebulæ may, however, be visible as silhouettes against a luminous background, supplied by dense star fields, as in the Milky Way, or by luminous nebulosity, or, possibly, some faint general luminosity of space (a condition that Prof. Barnard thinks may exist). There are in the heavens many dark spots, of striking appearance, which have generally been assumed to be merely starless regions. The author presents photographs of some of these, and expresses the suspicion that "most of them are really dark or feebly luminous bodies shown in relief against a brighter background," though some are doubtless real vacancies. That a nebula may lose its light is proved by the case of Hind's variable nebula in Taurus, which, after having been a conspicuous object in small telescopes, ceased to be visible in the most powerful instruments. At present it is feebly visible in very powerful telescopes. Dark nebulæ may have lost their light or may never have been luminous. Since they are opaque they must be relatively dense, and hence their great mass needs to be considered in studies of celestial mechanics.

Automobile Notes

Shortage of Material Imminent.—It is beginning to be acknowledged by the automobile trade that serious difficulties on account of shortage of materials is imminent, and that as a result either prices must be raised, or substitutions must be made. Of course no first-class company would consider the latter alternative, as their reputations are too valuable, but some of the weaker houses will undoubtedly be compelled to this course or suspend operations. Even the larger manufacturers who have long term contracts with the producers of materials are having difficulty in maintaining their supplies and this through no fault of the material men, as they too are having their difficulties in getting their raw supplies, and the future looks serious for many smaller manufacturers and assemblers.

A New System of Repairing Tires.—The procedure of the average repair man when mending an injured tire has heretofore been decidedly crude, for he did not remove the damaged parts but simply laid on one or a series of patches that destroyed the resiliency of the tire in their neighborhood, and which, on account of their unsuitable or unyielding character, were sure to work their own destruction in time. One of the prominent tire companies has given out instructions for making correct repairs which include the complete removal of all defective portions, and the insertion of proper materials to effect a perfect renewal of the injured portion of the tire. The instructions are very simple and clear, and no new tools are required to carry out the improved methods; moreover, the cost and time are not increased. The improved methods will be appreciated by all automobilists in view of the increasing cost of tires.

Simplified Lubrication.—It is by no means unusual to find automobiles that require lubrication in eighty or more different places, and everyone of these requires careful attention, some every day, others once a week, while a few points will go six months without renewals; but it is very probable that some owners never discover all the little cups and holes provided for the lubrication of more or less essential parts. In such cases there is bound to be excessive wear on the undiscovered points. One of the most interesting cars seen at the recent show in New York was a foreign car where simplicity had been carried to most surprising degree, and in it there were but eleven oiling points in the entire motor and chassis, and even these required attention but once in six months. This result was attained by ingenious oil circulating systems, and the providing of capacious reservoirs by the drilling out of various shafts and fittings. Best of all, there appears to be no doubt as to the efficiency of the arrangement.

Pumping Oil in Cylinders.—Complaints are often heard that the action of the piston in an automobile cylinder tends to pump the lubricating oil up into the combustion space. A simple remedy for this condition, which is said to be satisfactory, is to round off very slightly the upper outside corner of the upper piston ring and the lower corner of the lower ring. This does not affect the compression in the least, and the action is to permit the upper ring to pass the oil on the cylinder walls on the up stroke instead of scraping it up to the top of the cylinder, while on the down stroke the surplus oil is scraped back. On the other hand, the up stroke of the lower ring tends to carry the necessary oil for lubrication up the cylinder wall, while on the down stroke the rounded lower corner of the ring would pass over the oil thus distributed and leave it behind. The intermediate rings should have both upper and lower corners eased so as to disturb the oil as little as possible, allowing it to remain and perform its function as a lubricant.

A Cemented Tire Causes Loss of Battle.—That a poorly cemented "solid" rubber tire could have a deciding influence on a battle would be incredible were it not for the letter a driver in the Supply and Munition Column, of British Army Service Corps in France, to a friend in England, describing how a fight near Ypres was lost by the British some months ago. The tire was on the front wheel of a big motor truck leading an ammunition column at high speed towards the scene of the heavy fighting. Suddenly the entire outside of the tire came off, leaving a layer of rubber around the wheel about half the thickness of the original tire. The truck swerved violently, finally going half into the ditch and blocking the road for nearly half an hour. In the meantime a section of the British front had to fall back because of lack of ammunition. Examination of this tire showed that it had evidently been made up of two layers with smooth edges, the two halves being cemented together. Under the heat and friction of the drive the two halves came apart and the expensive accident resulted. Truck tires of this type usually are molded from one single piece, and an investigation is said to have been started, with the idea of discovering whether other tires from the same factory were made in a similar manner.

Houdini's Strait-Jacket Mid-Air Escape

ON March 20th the employees of the Custom House in New York City were treated to a unique spectacle when Harry Houdini, the "Handcuff King," was suspended by the heels at a dizzy height of 60 feet over the subway excavation at the Battery. His arms were confined by a specially constructed strait jacket—the ordinary article of commerce intended for the restraint of the insane, being about as much good to Houdini as would be a strait jacket made of sheer lawn. His heels were securely tied and his arms were pinned by the enormously reinforced strait jacket. He was then swung out by the derrick by his heels head downward, and in the course of five minutes he wriggled himself free.

The well known vaudeville entertainer does not make any trick of this act. It is a feat of strength and skill. When his challengers have fastened him in the strait jacket he elongates his arms by partial dislocation giving him at least 3 to 4 inches of free space, and this space is practically the key to his strait jacket releases. He manages to writhe, struggle and by sheer muscular strength gradually work the arm straps, which are buckled behind into the small of his back slowly but surely toward his head, and eventually manages to get the binding straps over his head where with his teeth he opens the first buckle. His hands are trained to loosen things through the canvas sleeves and in this wise he opens the remainder of the straps. He has often performed this trick on a floor, using it as a lever, but it is a great deal more difficult to free himself in mid air. On the first occasion that he tried this act it took him one hour and 50 minutes and he could not work for several weeks.

Houdini states that he first conceived the idea of this act when going through a lunatic asylum where one of the unfortunate inmates was confined in one of these distressing contrivances. He asked the superintendent for a strait jacket and proceeded to try the experiment. The life of the ordinary strait jacket however, was not very long, as Houdini, with his immense strength burst it asunder almost immediately. It gave him the idea, however, of a very sensational act.

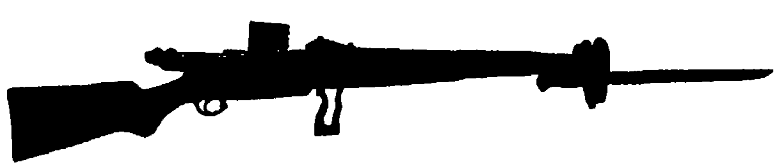
Houdini releasing himself from a strait-jacket while suspended in mid-air, with head downwards

A New Type of Military Rifle Fitted With a Bayonet Shield

THE present war in Europe has not shaken the standing of the infantry rifle as a weapon of offense and defense, despite the introduction of marvelous artillery, machine guns, hand grenades and many other accoutrements of modern warfare. If anything, the rifle has proved more indispensable than ever, especially in conjunction with the bayonet.

Bearing these facts in mind, much interest cannot fail to be attracted to a new type of military rifle and bayonet shield that have been invented by a former Greek army officer, Demetrius Stergianopulos, now residing in the United States. His rifle is unique in that it is provided with a magazine holding eight cartridges, which are discharged with great rapidity by the movement of a handle situated under the rifle stock well forward of the butt. In the conventional type of military rifle the bringing of the cartridges into position is effected by operating the bolt mechanism which necessitates removing the rifle from the firing position each time a shot has been fired. In contradistinction to this method, the Stergianopulos military rifle ejects the shell of an exploded cartridge and moves a fresh one into place by the simple movement of the handle previously mentioned which also serves as a convenient grip for the left hand in holding the firearm, in fact it is claimed that this method of holding the rifle is less trying than conventional practice in which the wrist is awkwardly bent so as to allow the stock to rest on the palm of the hand. Because the rifle need not be removed from the firing position in bringing a new cartridge into place, the inventor claims that it can fire 50 rounds per minute, or three times faster than any other military rifle. Again, the chamber actuating lever affords an ideal method of holding the rifle during a bayonet charge, for it permits of throwing greater weight into the thrusts, besides, since the breech mechanism can be actuated while holding the weapon in position for a bayonet charge the rifle can be discharged during such an attack the advantage of which is immediately obvious.

Despite its superior features, the new military rifle is of the same weight as the German infantry rifle, the Mauser, which tips the scale at nine pounds. However, the Stergianopulos has the advantage of taking eight cartridges at a loading as against the six of the Mauser. The chamber actuating handle under the stock is, of course, an exclusive feature which gives to the rifle manifold advantages. It is provided with a safety device which locks the handle in place so that a soldier has something firm to grasp when so desired.



Military rifle which is operated by a lever placed under the stock, and provided with a bayonet shield

In connection with his military rifle, the Greek inventor has devised a steel guard which is claimed to be most efficacious in protecting the modern infantryman, while charging, against any thrusts or blows from the enemy's bayonets and swords. As will be noted in the accompanying illustration, it is placed at the end of the rifle, at the base of the bayonet's blade. Small as the shield is, its use affords considerable protection to the user, while its construction is such that it may readily be adapted to any military rifle now in use.

So well have the French military authorities thought of Stergianopulous' rifle and bayonet shield that the French Military Commission in New York City, having seen his rifle last year, invited him to go to France. Accompanied by French officers, the inventor went abroad and demonstrated his weapons in the presence of an especially appointed commission. The French government delivered to him a Lebel rifle and cartridges, with the order to adapt, if possible, his rifle to the French 7 mm. cartridges. This he has done, and the rifle is now in the hands of that government.

An Automobile Speedometer That Operates by Air Friction

DEPENDING upon the principle of air friction and consisting essentially of two metal cups fitting one into the other, but not touching at any point, a speedometer has been developed to a commercial stage after three years' experimenting on the part of a leading watch company.

The new speedometer is unique in that it does not employ the centrifugal nor the magnetic principle as do the other types of speedometer in general use, instead, it relies on the friction of air as developed by metal surfaces. The two main components of the speedometer in question are a driving cup, which is rotated by power from one of the automobile wheels through the flexible shafting, and, suspended over and around it a driven cup. The driven cup, which is also the indicating one since the numerals representing the miles per hour attained are marked on its periphery, is inverted over and around the driving cup, as will be noticed in one of the accompanying illustrations. This cup, as is also true of the driving cup, in reality consists of a double cup.

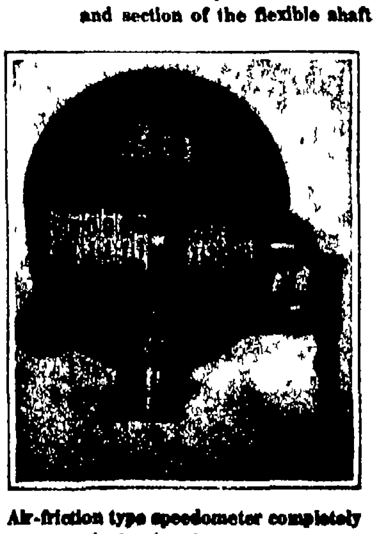
The driving cup of the speedometer comprises two concentric brass cups with a spacing of 108 centimeters between the two vertical walls, called "ribs" for convenience, both of which are rigidly mounted on a vertical shaft so as to revolve in perfect unison. Likewise the driven or indicating cup is made up of two aluminum cups attached together so as to form a single cup insofar as its mechanical operation is concerned. These cups are extremely light being made of aluminum 008 centimeter thick. This means that 313 of these cup thicknesses would be required to total a thickness of 1 inch.

The driven cup when in position in the instrument has its inner rib floating in the annular space between the ribs of the brass cup, while the outer rib of the aluminum floats outside of the brass cup. There is an air space of 5 millimeter between the ribs of the brass and aluminum cups. In one of the accompanying views may be seen how the two cups are telescoped.

Brass and aluminum cups used in the new air-friction type speedometer, and parts and section of the flexible shaft which is assembled without a rivet

The operation of the new speedometer is of the utmost simplicity. the revolving of the brass cup generates the air friction which, were it not for a regulating hairspring serving normally to maintain the aluminum cup at the zero marking would cause the latter to revolve, in other words, the air friction developed serves as a means of transferring the driving power from the brass cup to the aluminum cup. The hairspring is so adjusted as to permit the aluminum cup to be affected by the air friction in direct proportion to the speed of the brass cup, so that the reading of the instrument will be correct.

The air friction developed in the instrument has been proved to be directly proportional to the speed of the revolving cup. It is this fact that has made possible a uniform calibration without introducing compensating devices to gain this end. Comprehensive laboratory tests are reported to have proved that air friction is not influenced by heat, cold or altitude up to 10,000 feet. The revolving cups, contrary to expectations, do not have to be carried in an airtight compartment, and no sealing is necessary. The regulation between the tension of the hairspring and the tendency of the aluminum cup to rotate under the influence of the air friction is so delicate that the instrument indicates immediately all speed changes and indicates as low as one half mile per hour. Yet the instrument is so sturdy that its accuracy is not affected by vibration in regular service.



Air-friction type speedometer completely assembled, showing the arrangement of the parts

Method of mounting the driving and driven cups in the new speedometer

Counting the tails of captured rats to determine the rat-catcher's remuneration at a penny apiece

An official rat-catcher and his dog, with their "bag" of rats from French trenches

How the French Soldiers Wage War on Trench Rats

AMONG the grisly phenomena attendant upon war one of the most offensive and dangerous is the plague of rats to which it always gives rise. Thus the black rat is said to have been brought into Europe at the time of the Crusades, while the "rat of the Goths" and the "rat of the Huns" were terms given to the predatory rodents who were camp-followers of those predatory barbarians. The reason for this unpleasant fact, to which the present European war offers no exception, is not far to seek. Where men gather in hordes to slay each other there is abundance of provision, both of the grain which some varieties live on, and of the carrion that tempts others. Moreover, sanitation is imperfect, and finally, the rats are permitted to breed unchecked. Since the female is fertile at the age of three months, and casts several litters per year of from 9 to 18, the rats rapidly grow into an appalling army. This is exactly what has happened in the trenches of France, until the matter has become so serious that the authorities have been obliged to take vigorous measures to abate the nuisance not merely because of the complaints of the soldiers that both food and clothes are destroyed, but because of the many cases in which the men have been bitten. Owing to the filthy habits of the rat and its deadly fare of putrifying cadavers, such bites may cause grave infections, which may also be spread by its droppings upon food.

The French press is giving much attention to the matter, and a recent supplement of the French encyclopedia, *Larousse Mensuel*, contains an exhaustive article, to which we are indebted for the facts contained in the present article.

Rats have many enemies, including the dog, the cat, the ferret, the weasel and the owl, and all these aid man in their destruction. Besides this, they may be taken in traps, again, they may be suffocated or poisoned. Lastly, they may be exterminated according to the very subtle and modern method of infecting a few with a pathogenic culture. The disease rapidly spreads because of their cannibalistic habits.

The method chosen must be adapted to circumstances. Traps are probably best where only a few individuals are concerned. But as the rat is extremely wary, care must be exercised to see that the trap is not contaminated by the odor of human hands or of previous victims. If necessary, the wires may be touched with a few drops of the essence of anise, to which rats are very partial. The trap must be put in a dry place and disguised as well as possible, and the bait should be attractive and varied. It is advisable, too, to make it of a kind not easy to get. Thus meat or cheese in a granary become unusual delicacies, to be sought by the epicurean rodent.

Where large numbers are to be destroyed, chemical poisons are commonly used. Arsenic or arsenious acid has long been thus employed, but its slight taste and odor and its resemblance to flour have led to its disuse at present, since it so easily lends itself either to accident or to crime. Carbonate of barium mixed with flour to form biscuits has been proposed, and phosphorus is peculiarly toxic to rodents. Several vegetable poisons have also been suggested, among them *nux vomica* and the toxic extract of squills.

Mechanical poisons, such as crumbled sponges or a mixture of plaster of paris and flour, are sometimes used. In this case buckets of water are placed at hand, and the thirsty animal succumbs to internal pressure after drinking. Asphyxiating gases are effective in some instances, especially fumes from disulphite. A few centimeters of this, introduced into a burrow, will slay all the residents. It is much used to exterminate field mice, about 8 or 10 kilograms to the hectar being required. In isolated burrows a successful method is to throw in a few fragments of calcium carbide, stop up the exits, and then pour in water. The mice are

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Is the Chinese Dragon Based on Fact, Not Mythology?

By J. O'Malley Irwin

DURING the latter part of a holiday trip in the Yangtze Gorges undertaken by my wife and self in November, 1915, we met Mr. M. Hewlett, British Consul at Ichang, and his wife, and in their company spent a day in the Ichang Gorge, landing at various points to climb the cliffs and explore some of the numerous caves.

While exploring a large cave on the right bank of the river, about one mile above the Customs Station at Ping Shan Pa, we discovered the fossils about to be described. The cave is reputed by the Chinese to extend some 20 miles to a point near Ichang. It is reported that a party of bluejackets from H. M. S. "Snipe" spent three days in the cave some years ago and that they failed to reach the end. Evidence that this party penetrated beyond the point where the discovery was made exists in the name of their ship painted on the cave walls at a point considerably farther in. The Chinese name of the cave is Shen K'an Tzu, which means "The Holy Shrine," and one of the characters forming the word K'an is the Chinese character for "dragon." A large rock is seen at the entrance, and some eight or ten yards behind this there is a peculiar piece of curved rock bearing some slight resemblance to a portion of a dragon's body, the resemblance is possibly suggestive enough to impress the Chinese mind, but

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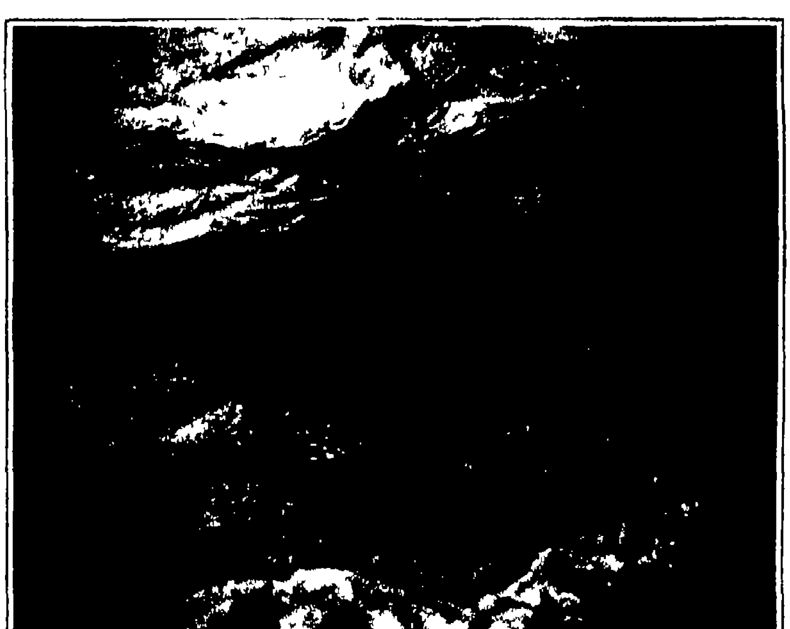
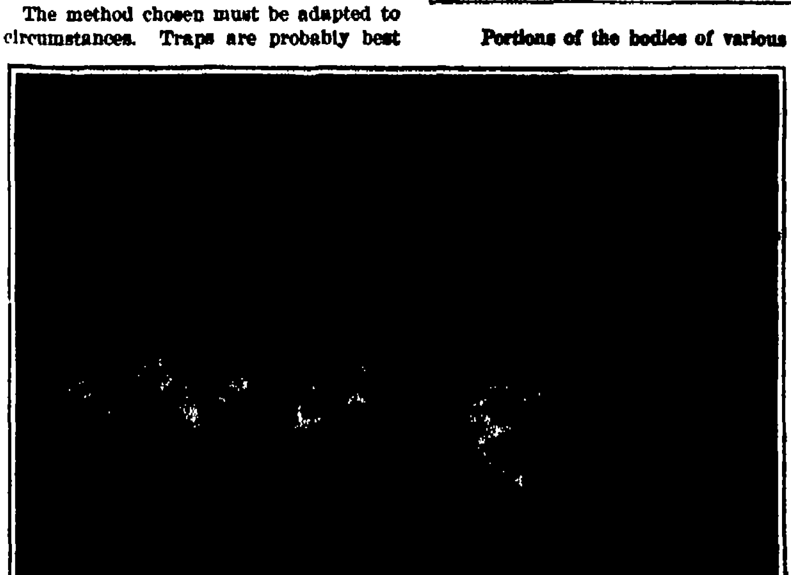


Portions of the bodies of various reptiles as they lie in the Chinese cave



Coil of an extinct reptile in the foreground, two feet in height

A near view of the body of an extinct reptile, showing scale formation

Industrial Preparedness for Peace

VI. Planning and Dispatching

By Miner Chipman

JOHN HOLT had been manager of the plant for 22 years. The factory consisted of a small wooden building with four machines and 30 workers when he first took up the reins of management. He had seen the business grow from a volume of a few thousand dollars per annum to nearly two million. He was proud of the achievement. He handled the multitude of details in much the same manner as he had handled the simple operations of management 20 years before. The time clock, the telephone and a species of cost keeping had in their time entered in the routine transactions of the plant. Looking backward John Holt could see vast improvements in the management of the factory, improvements he had devised and introduced. That anyone could question his success as a manager was not to be imagined. His attention was devoted to manufacturing. He knew little or nothing of the problems of distribution. The sales department was a very insignificant and unimportant function of the business insofar as John Holt was concerned. It must be easy to sell "his product," there was no real job about that. He never associated the net earnings of his company with his manufacturing problems. He knew or thought he knew that there were no wastes in his factory. If the company did not make money it must be because of selling at too low a price. The sales department must be to blame. On several occasions he had visited the factories of competing companies. He had been shown the new systems of planning out the work of the factory. These new devices had impressed him as so much red tape which he vowed should never be imposed upon his organization. He had read with more or less interest certain books on efficiency and scientific management, the president of the company had given him. He realized that certain very remarkable things had been accomplished by these experts, but could discover no analogy between the factory operations described and the operations involved in his own factory. He could see just how these scientific principles could be applied in the "machine shop" but was satisfied that no such scheme could be worked out in his factory.

Forced by Competition

John Holt had always prided himself upon the fact that all betterments to plant, method and system had been suggested by himself. His long experience had led him to believe that no suggestion of real worth could come from without. It was a matter of great surprise, and grave concern to John Holt, when he was suddenly called into conference with the president, and introduced to a stranger to whom the president gave the title of Efficiency Engineer. The chief executive went on to say that the company was not making profit. Competition had grown to such an extent that something radical must be done. He was quite satisfied with John's management, but felt that the new efficiency methods might be applied to the factory. John struggled to maintain his poise. It was difficult. He had a strong inclination to resign. He felt that the introduction of the "efficiency man" was a personal affront, a reflection upon his experience, ability and prestige. He controlled himself and kept silent. The efficiency man was employed.

An Experiment in Efficiency

The "efficiency engineer" introduced by the president to John Holt had been placed in the same position many times before. He had been given authority by the board of directors and the president of the corporation. It had been his habit to "force" efficiency systems into a plant, and it had mattered little to him whether or not the manager or the superintendent liked it or not. A number of experiences in forcing efficiency had awakened within him a realization that the method was not strictly scientific. Very gradually the thought evolved in his mind that there must be a better way. His first visit with John Holt convinced him that the time had arrived when he should make a new departure in the method of introducing "efficiency" systems. He started out, therefore, with a different attitude toward the management, and a different viewpoint toward the wastes of inefficiency. He laid down as the first principle of his new experiment the following:

"The first duty is to know, to understand, and to appreciate the attitude of the management."

Instead of placing John Holt upon the defensive, he placed himself upon the defensive. Holt was not the kind of a man to be forced. There was a possibility of his being convinced. If we have the power it is much easier to force a man than it is to convince him. It takes power and creates much friction, and altogether it is an expensive undertaking. As he sat talking with John Holt he made up his mind to get his view point, and appreciate just what that business meant to him, and what John Holt meant to the business. The experience was really refreshing. He purposely refrained from relating his previous exploits. He did not mention the word "efficiency." He was careful not to allow the word "waste" to enter the conversation. Given half a show, he found John Holt very much a man.

Habits and Viewpoints

In the first place, he found that John Holt was not opposed to efficiency methods. John Holt thought he was efficient and the methods he used were likewise efficient. John Holt was not satisfied with things as they were. Not at all. He had many plans for improvement, and had suggested many things which had been rejected. With all his pride for his achievements of the past, he had many disappointments. Things had not always worked out in a way just to suit him. As soon as he found that the "efficiency man" was willing and ready to listen and was not attempting to force upon him a new world of technical words and phrases, he began to pour himself out—his real self, and the real John Holt began to be known. Without any strain upon the imagination he could see him as he would have been if he had used the theory of "force." He began to realize that he was on the right track. John Holt was very human, and being human was made up of habits and viewpoints. Given an opportunity to tell something of his experience, something of his inner life, the engineer began to appreciate the meaning of these habits, and to discover the reason for his viewpoints.

Planning and Dispatching

He soon discovered that he too was made up of habits and viewpoints. The principles of scientific planning and dispatching had grown to be a part of him. He attributed any objection to his orthodox plans and systems to ignorance and cantankerousness. When he sat down with John Holt to discuss the planning and dispatching of work through the factory, he was immediately confronted by grave difficulties. He found that John Holt was convinced that orders were well planned and efficiently dispatched through the plant. He felt that he was in close touch with every transaction in the factory. He could call any foreman on the telephone in a moment and get the facts about any order. What more could be asked? From an examination of the orders the engineer had discovered that deliveries were not being made according to promise. He had difficulty in tracing certain orders. He found where certain parts of the order had been waylaid and lost in the process. He knew all of these things, and yet he could see that John Holt conscientiously believed that his management was 100 per cent efficient. To demonstrate to him that such was not the case would be exceedingly difficult. He had not only John Holt to convince, but a corps of foremen, and a large number of workers. John Holt typified the organization. If the efficiency engineer's experiment was to be tried out he could not assume that the whole plant was ignorant and cantankerous. He set himself to work, therefore, in a study of the planning and dispatching problems of the plant. He made up a check sheet of all orders coming and followed them day by day through the plant. He made up what he called a Daily Report of Work in Progress, which showed at a glance the following:

(1) Orders on file and untouched
(2) Delivery promises
(3) Orders started
(4) Orders in progress by department.
(5) Work done upon orders by department
(6) Department balances
(7) Delayed orders, and cause of delay
(8) Failure to deliver on promise

He kept this sheet running for about 30 days. He had proved his case insofar as his own satisfaction was concerned. He realized that it would not do at all to turn this evidence over to the president, or present it to John Holt. The result would have been an explosion in either case. During all this time he had been having daily conferences with John Holt, and had made an intimate acquaintance with many of the foremen and workmen. The time had arrived for action.

The Open Forum

The efficiency man procured the use of one of the rooms in the Board of Trade and issued written invitations to 100 or more of the men. He followed up this invitation by a personal request for their attendance. He stated that he would talk about efficiency and efficiency systems, and that he wanted every man to come loaded with questions. On the appointed evening he was confronted by about 25 men. He talked for one hour, and told them the story of his work in other and similar manufacturing plants. He said nothing about their own work, nothing about his discoveries in planning and dispatching. When he had finished he passed through one of the most strenuous ordeals of his life. That group of workers and foremen flooded him with a stream of questions. These questions were not theoretical, they were exceedingly practical. He found himself facing facts not arguments. Looking backward he was convinced that his audience got the better of it. We adjourned the meeting at midnight, and he promised to meet them again the following week.

Demonstration of Principles by Analogy

In the meeting which followed he worked out with these men the underlying principles of shop management. Given a proper opportunity to express themselves, he found that each meeting cleared up many of the more perplexing problems. In his talks he refrained from discussing "principles." He took particular problems in management, and by analogy and illustration forced these men to evolve a solution. The end of every meeting found us closer together. He discovered that the company had many "efficiency engineers" in their employ. The men had developed into efficiency men through practical experience, while he had gained his reputation through an exposition of principles. The combination of the two was bound to succeed. The method he used for demonstration of a principle was usually through the medium of "play." He "put over" the idea of scientific planning and dispatching by playing a very interesting game with a number of decks of cards. It was successful because it was simple.

A Model Factory

He purchased at the 10 cent store a dozen decks of playing cards. Four decks of the standard size, four decks of a medium size, and four decks of the "baby" size. He selected cards having a differently designed back for each deck. Each deck consisted of 52 cards with a Joker and an advertising card. He had, therefore, 648 cards, and 12 boxes. He opened the boxes, and threw the cards into a suit case with the wrappers. He then shook the suit case until the cards were thoroughly shuffled, faced and mixed up generally. He then said:

"Gentlemen: We are going to open a factory. I have here in this suit case all of my raw materials. Out of these raw materials I want you to make for me twelve decks of playing cards. I wish to have each deck arranged as follows: Ace low, King high, arranged in order, and piled in the following order: hearts, diamonds, spades and clubs, Joker, advertising card, and placed in the proper box. I can only accept perfect work." He then selected three men out of the group to perform the functions of the organization. He handed one of the men the suitcase, took out his watch, and said, "Go!"

It was an example of pure socialism. Each of the three wanted to be boss. There was no head. They wasted several minutes in discussion before they opened the suit case. The cards were in a condition of chaos, so were the men. It took them just 48 minutes to "deliver the goods." In the meantime the group had been watching the operations of the three with merriment and occasional suggestion. The obvious inefficiency of the operation had impressed itself upon the mind of every man in the room. The engineer called for volunteers, and selected three more men. They made an immediate improvement. They cut the time down to 30 minutes. Before the evening was over the entire group had entered into the spirit of the game, and a picked group of three men finally made a record by performing the operation in 14 minutes and 45 seconds. Even at this stage, there were many suggestions wherein seconds could be saved. There was not a man in the room that had not "held his watch" on his fellow workers. Everyone of them had been counting time on the second hand. They had never realized the importance and significance of a "second."

The Seeds of Efficiency

He went home that night thoroughly satisfied. He had planted the real seeds of efficiency. He knew they would

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Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Open Sights vs. Peep Sights

To the Editor of the SCIENTIFIC AMERICAN.

I am honored by having Mr Walter Winans, one of the best known big game shots in the world, and the running deer champion, disagree with me as to the optical performance attaching to the use of open sights on the rifle (SCIENTIFIC AMERICAN, January 22nd, 1916, page 99) While agreeing with me in my review of the military rifle sights of the world in "How a Rifle is Sighted," Mr Winans does not agree as to the details of the stages in aiming over open rifle sights

Mr Winans' letter is an amusing example of the difference between what one does, and what one thinks one does. He states that he does not see the rear sight ever as blurry or fuzzy, nor yet sharply for an instant and then change his focus to the front sight, some 20 inches or so farther up the barrel and ergo in a different focal plane from that of the rear He states that he entirely "ignores the rear sight." He states that without looking at the rear sight the front goes instinctively into the right position in the notch, and then to the right spot on the game

Inasmuch as the description of his sighting applies properly and entirely to the peep sight alone, and never to the open sight so far as actual optics are concerned, we are impelled somewhat to examine into his statements If we could do with the open sight what he says he does then we would not condemn, as we do, the open sight.

The open sight system of a rifle consists of a small bead or other form at the muzzle of the rifle this usually about one sixteenth inch in diameter, and on the barrel of the rifle near the breech, and usually 20 inches to the rear, a bar of steel, with a notch cut in it, so proportioned as to show the front sight with a little light around it

The rear may have its notch in wide "V" shape, or in narrow "U" notch according to the preference of the shooter or the peculiarities of the maker of the rifle, but always the principle involved is the same This is that the rifle is correctly sighted when the front sight touches the mark in the right spot, and then is drawn into the notch in the rear sight in the position selected by the rifleman as his standard sighting

If Mr Winans will consult his oculist he will learn that when one object lies in a plane say 12 inches from the eye, and another object in a plane 32 inches from the eye, the two cannot be seen sharply with the same focal adjustment of the eye any more than the two can be photographed sharply with a camera set for either one, and the lens wide open. Neither is far enough away from the eye to be in what is practically the hyperfocal or the universal distance of focus from the eye-lens.

Ergo the optical portion of seeing either sight clearly consists of focusing distinctly for an instant on either one to the exclusion of the other Or if one is seen sharply all the time, the other is seen, if at all, blurred and fuzzy as stated.

That this is precisely what the eye has to do is proven by the fact that men on whom age is creeping, must abandon the open sight principle and use the peep, which does not entail this leaping of eye and change of focus from one sight to the other Stiffened muscles of accommodation prevent this. The writer, as instructor in the militia, and as secretary of the strongest rifle club in this country and as "consulting arms expert" for *Outing* and other magazines for some years, has so repeatedly and so successfully prescribed the peep sight in place of the open for men with eye troubles, that he knows beyond peradventure of the success of such change.

While target shooting entails finer sighting than does most big game shooting, still target shooting is at a contrasting mark and so not so much more difficult in sighting process than is big game aiming This being so let us consider the record of riflemen using open sights.

The British have for years used the open sight on their service rifle, the Lee-Enfield The United States has used the peep for years on its service rifles.

The poor British rifleman, using this open sight, is compelled to use an "orthoptic" spectacle to enable him to define front and rear sight sharply This orthoptic consists of a steel plate set in an ordinary spectacle frame, and pierced in front of the eye with a very fine hole. In the finer grades this hole is adjustable in size with an iris diaphragm just as is the lens opening in front of the camera lens.

In effect this sharpens up the vision and makes the focus of the eye nearer to the desired universal focus, just as stopping down a lens increases the depth of the focus of the camera lens. This is a standard article of equipment in British rifle shooting

Despite even this freak aid to aiming, the American rifle team in 1908 visited Bisley and wiped up the ground with the British and other rifle teams in typical and prayed for British weather The American team used peep sights, the British team the open sights to their disgust.

In 1912 the American team went to the Olympic games at Stockholm and there once more wiped up the Swedish earth with the British and every other rifle team using open sights The British were not outgunned, their match ammunition was as good as ours, they were out-sighted, despite being possibly better in dividual shots than our men.

So much for the accuracy of the open sight in tests that are open and above board tests or sights

Now let us consider Mr Winans' reported performance of ignoring the rear sight and seeing but the front one

In a rifle stocked exactly to fit the rifleman, fired with no great desire for high accuracy, and a rifle to which the rifleman is as accustomed as he is to his gloves, this is partially possible

Before accepting this dictum of what Mr Winans says he does for what he really does—which are horses of different colors—let us consider the ballistics of the matter

In the case of sights 20 inches apart, a fair average for sporting open sights, we have a radius of 20 inches, a diameter of a circle of 40 inches, using the rear sight as the center from which we strike our circle, and hence a circumference of 128 inches. Inasmuch as a circle contains 21 600 minutes of angle, a minute of angle with our radius stated is just .0058-inch long on either sight

A minute of angle includes one inch for each hundred yards of distance, accurately 1.047 inches In other words the error of a minute of angle on the sights means the error of an inch for each hundred yards of range the mark stands from the muzzle Ergo the error of .0058-inch in aligning the sights means an inch error at 100 yards, 2 inches at 200, etc.

The width of the common front sight hunting bead, or 1/16 inch, includes with our stated sight radius practically 11 minutes of angle, because in decimals the width of the front sight is .0625, and the width of a minute of angle is .0058 Ergo if Mr Winans makes the small error in aligning his sights of just the width of the small front bead, he puts his shot 11 inches wide at 100 22 inches wide at 200, and 33 inches wide at 300, all of which is unhappily sufficient to miss the vital spot on a brute if not the entire body Such errors in elevation are very easy to make, particularly as open sights are sensitive to changes in light, which make the notch more distinct and alter the apparent relation of front and rear

Half this error or half the width of the front bead or 16 inches error at 300 is not good shooting, and yet half this means but 1/32 inch in the position of the front sight in the rear notch.

These being the figures and the performance pertaining to the use of the open sight, the reader of the SCIENTIFIC AMERICAN will agree that if Mr Winans can pitch his trusty sporting rifle to his shoulder and without looking at or ever seeing the rear sight, place the front sight in the rear notch with less than a 32nd inch error each time, he must have a rifle fitting him to perfection or be very lucky or both

What Mr Winans does do is to perform the operation of glancing at the sights so rapidly as to be practically instantaneous, but our armies are not made of a few million duplicates of Walter Winans, big game shot extraordinary, nor are military rifles made to fit like a suit of clothes as are the rifles of Mr Winans Such men have to aim slowly, have to fish for front, then rear, and cannot depend on long practice and well fitting rifle to enable them to practically ignore the rear sight. Hence the undesirability of the open military rifle sight.

Using the typewriter has as much to do with sighting a rifle as using a typewriter has to do with trundling a wheelbarrow In one case we become so accustomed to the keyboard that we write by "touch," training of the fingers to stay in certain position over a familiar keyboard.

In the other we have a lot of men very unfamiliar with the rifle, compared with the experience of Mr Winans, and they cannot use "touch" and they must perform the operations of sighting as I have described them. And the greater their deficiencies of eyesight, the greater will be their error in sighting with open sights.

The dictum of Mr Winans as to the superiority of the open sight over the peep may seem very conclusive to Mr Winans. The cold fact of a few hundred thousand American riflemen paying from $2 to $6 additional for peep sights on their sporting rifles each year, would seem to throw some little doubt on the conclusiveness of Mr Winans' findings.

The matter boils down to the fact that Mr Walter Winans, a Baltimore American but thoroughly imbued with the conservatism of his adopted "right little, tight little isle," prefers the open sights because most British rifle makers prefer them and install them and most British hunters conservatively follow

The other fact still remains—that target riflemen, who desire only to hit what they fire at American big game hunters in the proportion of two to one the American ordnance department of the army and optical science all declare in favor of the peep sight

The open sight is efficient in spite of optical difficulties so long as the eyes hold out

The peep sight is efficient because it complies with optical facts and it is efficient regardless of the eyesight.

EDWARD C CROSSMAN

Los Angeles, Cal

The Auroras of Iceland

To the Editor of the SCIENTIFIC AMERICAN

During the last two months there have been some magnificent auroras visible here at Akureyri notably during the former half of October and the latter half of November

On the 6th and 7th of October last, I observed some splendid auroral arcs crossing the sky from east to west, as usual a short distance north of this place and rising from 30 to 70 deg above the horizon

From the 13th to the 22nd of November the auroras were extremely brilliant. Those of the 13th were particularly beautiful Words alone cannot describe their beauty Between 6 and 7 o'clock in the evening of that day, there appeared suddenly a stream or wand of light above the horizon and to the northwest of this town. In a twinkling of an eye this stream of light extended itself across the heaven forming an arc of continuous light even to the western horizon The latter is formed by a range of mountains 1,500 meters high and 15 kilometers distant, while along the eastern horizon runs a heath about 1,000 feet in height and 6 kilometers distant The arc of auroras crossed the sky just beneath the Great Bear (Ursa Major) constellation, and remained there growing in brightness for a few moments, resembling an immense band or fringe of light, made up of dazzling lances or spears of ethereal flame moving from east to west and west to east like a vast line of infantry Then, this arc was paralleled by another which crossed the Ursa Major constellation, a third crossed by the Pole star, a fourth crossed the zenith (Akureyri is situated on 65° 40′ north latitude) a fifth a little to the south, and a sixth and a seventh arc crossed by the Pleiades The seven arcs formed a bridge of continually moving light completely across the heavens.

This continued for some 10 to 15 minutes, during which time the auroras assumed at times various colors reflected by the moonlight Then the most northerly arc faded away as did also the most southerly arcs, but the second, the third and the fourth arcs remained a few moments longer when they broke up and rolled themselves into a vast spiral of dazzling light which outshone the stars and hid from view the cirrus clouds immediately above it

A similar though less brilliant display greeted the eye on the 14th the 15th and up to the 20th of November between 6 and 8 o'clock in the evening

On the 21st, three young men of this town saw about 6 15 to 6 30 in the evening, a brilliant stream of light dart up above the eastern horizon, and then form an arc of light across the sky just above the Great Bear, but below the Pole star After remaining a few minutes the arc rolled itself up into a spiral of light of great brilliancy which displayed all the colors of the rainbow

From 6.30 until 8 30 that evening I, myself, observed some very brilliant auroras, but the rainbow tints were not generally visible, these being probably due to reflected moonlight. At times the auroras were bright enough to hide some cirrus clouds immediately above them and were therefore at a lower elevation than these, but they were decidedly above the cumulus clouds which covered part of the sky

The height of these auroras has therefore been between 3,000 and 9 000 meters, and the most northerly arc which rose to 30 deg above the horizon has only been some 12 kilometers or good seven English miles north of this place

The auroral displays are most frequent and most brilliant in cold and clear weather and seem periodical Many reasons lead me to suppose them to be emanations of terrestrial energy rather than of solar energy

As yet there is no meteorological station of any value in Iceland although industrial, commercial and scientific interests demand one, as also an astronomical observatory, both here and in the southern section of the island

FRIMANN B ARNGRIMSSON

Akureyri, Iceland

An Irish flax worker spreading water-retted flax to dry and "nature"

A field covered with flax which is exposed for a number of days to the elements

Increasing the Profits In Flax Mills

How Simple Efficiency Methods Have Resulted In Higher Prices for This Commodity

By J. A. McCracken

THE flax industry is seriously affected by the war The present prices of flax fiber are about double those that obtained before the war Irish flaxes bring as high as 43 cents a pound Belgian flax as high as 60 cents Canadian dew retted flax has been sold in New England at as high as 25 cents, and a small lot of Canadian water retted flax at slightly over 45 cents a pound

The high prices and especially their wide range have been something of a revelation to Canadian flax operators If one man's fiber sells for only 16 cents and another's at 25 cents and 45 cents, according to quality, the low man naturally begins to take notice Formerly, when all shipments of Canadian fiber brought less than 14 cents (varying between 8 and 14 cents), the range of prices between lowest and highest was only a few cents per pound

The causes of these differences are wrapped up in the curing and manufacturing, as well as to some extent, in the crops as grown In concrete terms, varying skill and attention create a difference of between $200 and $500 a ton in final returns For the average crop of 300 acres, yielding 400 pounds of fiber per acre this difference would be

Three hundred acres at 400 pounds gives 60 tons at from $200 to $500 per ton equals $12,000 to $30,000

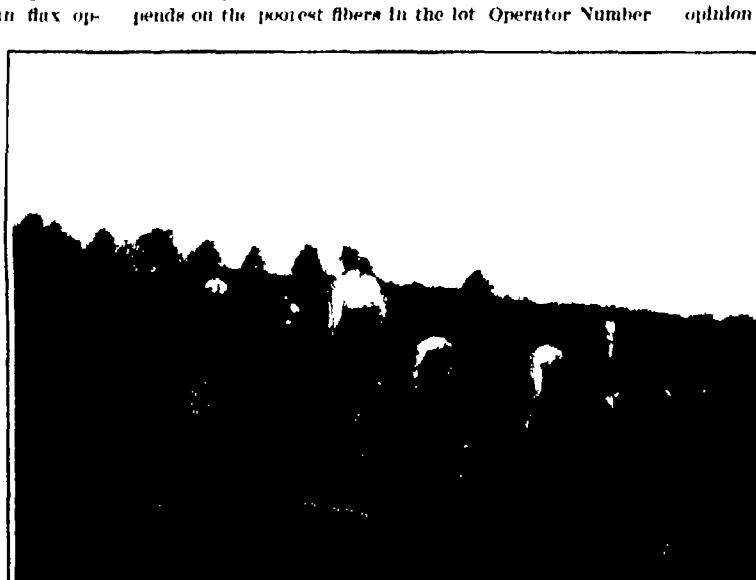
In a word, a crop of 300 acres handled at one mill would yield between $12,000 and $30,000 more revenue than the same crop handled at another mill, the two factories being at extremes in efficiency To accomplish this result there are, aside from the character of the labor involved, only minor factors and a small outlay to consider

Let us examine the processes that influence the final returns.

Harvesting

The progressive mill man sees to timely harvesting Realizing the danger of labor shortage—so common at flax plants nowadays—he sets his pullers in motion before the customary time thereby losing somewhat in the yield of seed, but gaining enormously in the quality and yield of the fiber in the fields last to be pulled Operator Number Two, on the other hand, does not start pulling until the flax has yellowed half way up the stem Therefore he ordinarily finds his last fields in process of deseeding and in second green before their turn comes to be harvested

As the price for a given quantity of mixed flaxes depends on the poorest fibers in the lot Operator Number One loses no opportunity of separating good flax from poor flax, and starts grading at harvesting time He pays extra to the pullers for making two or more separate lots, according to quality Fifty cents an acre spent for this purpose is a profitable investment Where short flax and long flax coarse flax and fine flax are mixed indiscriminately at harvesting, no amount of pains or skill at later stages can separate them economically



Spreading flax according to the old method of dew-retting

Retting

The importance of the system of retting is fairly indicated by the average price of Irish flax compared to the average price of Canadian flax This season the former brings between 38 and 43 cents per lb, while the latter—except for one small lot, water-retted—brings between 16 and 25 cents per lb The Irish and Canadian crops, as grown, differ little in quality But Irish flax is water retted, while Canadian flax, except for one departure to date is dew retted

The chief advantage of water retted over dew retted fiber is one of uniformity, which is obviously important in fine spinning The most satisfactory experiments in water retting yet undertaken in America are those connected with the exception cited above, in the form of experiments conducted at Forest, Ont. The fiber which has been produced in this manner has brought 45 cents per lb on the New England market This flax, by the way, did not receive the complete advantages of water retting, but only those of mixed retting, which means treating the flax half way in tanks and the balance of the process on the grass, as in dew-retting The operator, Howard Fraleigh of Forest, Ont., was satisfied to take one step at a time so as not to overreach himself, as some flax men have previously done

The two tanks already used at Forest are of concrete, each 25 feet long, 15 feet wide, and 4 feet deep They are placed end to end The water is supplied by a gasoline pump, from a well 108 feet deep, whose water tests 5.25 degrees Clark for softness and is quite muddy * It is only four miles in a direct line from Lake Huron, from which fact some have supposed that there is a subterranean connection with the lake This opinion is plausible in view of the shale formation of the lake bed opposite this point. Discharge from the tanks is through removable stoppers at the bottom to a public ditch.

The best fiber yet produced at this plant—the 45-cent lot—was secured from flax put direct into the tanks after it was pulled, that is to say, the flax was placed in the tanks without threshing or curing in the shock This is the method long famous in Ireland, but it is gradually being abandoned for the method by which the seed is saved In Belgium and Holland still more valuable fiber is obtained without sacrificing the seed The crop is carefully cured and frequently held over from one year to another in order that there may be material for steady retting from early spring until late fall Fraleigh intends hereafter to hold a portion of his straw over until the following year, and to start retting as soon as fine weather begins By this means not only will the straw be improved, but he can keep his men steadily engaged and can reduce his equipment for a given crop to the minimum

Each of the tanks mentioned above holds about two tons of threshed straw The sheaves are placed tightly in a leaning position in the tanks until all the space is occupied The mass is weighted with planks and stone so as to overcome not only the natural buoyancy of the straw, but also the added tendency to rise

* Note Rain water, which is the ideal liquid in which to ret flax, tests 8 deg Clark, upland surface water 154 deg and ordinary spring water 185 deg

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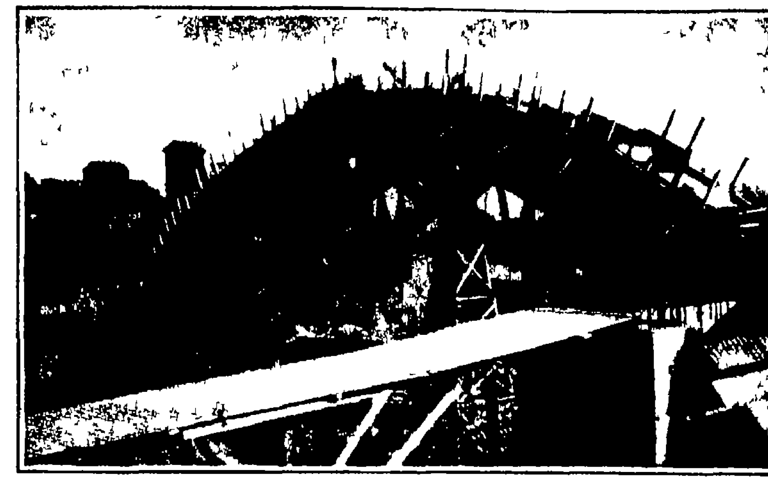
Examining and sorting flax before baling it

Two scutchers at work in the Forest flax mills

General view of one of the land sections of the Cleveland double-deck viaduct, in a partly finished stage



Wooden molds in place, supported by steel framework, ready for the pouring of the concrete

A Half-Mile Double-Deck Concrete Bridge

THE double-deck concrete viaduct now nearing completion in Cleveland Ohio, is the largest of its kind in the country The structure is 2,880 feet long and connects Superior Ave at West 9th St and Detroit Ave at West 25th St spanning the Cuyahoga river at a height that is sufficient to clear the largest lake steamers With the exception of the arch that spans the river proper, the entire structure is built of reinforced concrete The lower deck has six street car tracks while the upper deck is confined to vehicle and pedestrian traffic The latter has a 40 foot roadway and two spacious sidewalks

In the building of the Cleveland viaduct over 106,900 yards of concrete and 6,000 000 pounds of one inch steel bars, for reinforcement purposes, have been used Twenty five miles of concrete piling were driven for the secondary piers The river piers contain 20,000 cubic yards of concrete

Not the least interesting feature of the new viaduct are the 12 quadruple arches of concrete with an average length of 140 feet These arches were constructed by erecting temporary arches of structural steel upon which the wooden molds for the concrete were built The steel arches were of the adjustable type and after the concrete had been poured and become hardened, they were removed and erected to support other molds

The steel arch which spans the Cuyahoga river proper is the largest span of the double deck type in the country It is 591 feet from base to base Only two steel cantilever arches in the country exceed it in length—the one at Niagara Falls, and the Hell Gate bridge of the Pennsylvania railroad now nearing completion in New York City The crown of the arch of the Cleveland viaduct is 200 feet above water level and the two decks are suspended by hanger bars, the lower deck clearing the river by 96 feet.

The viaduct has a grade of 3 to 3 7 per cent, being 20 feet higher at the center than at its approaches The cost of the structure will be $4,500,000, it is estimated

Steel span section of the double-deck viaduct at Cleveland

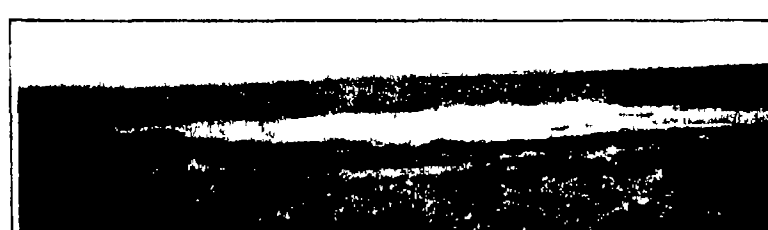
The Air Breakwater Put to Severe Test

A "BREAKWATER" of air bubbles can rob heavy waves of most of their destructive force. This has recently been conclusively demonstrated upon the Pacific coast. Much is reasonably promised because of that success, and the subject is of both spectacular and technical interest. A little over a year ago it was questioned in these columns whether or not Mr Philip Brasher's invention would turn out to be of practical value when battling with the very exacting circumstances of an exposed seacoast. Prior to that time he had given his "breakwater" trials in more sheltered positions, and while the results were decidedly promising they were not of a nature to answer our query

As can be recalled, during January just past, the Pacific coast was swept by a severe gale that destroyed much property along the shore and ravaged the sandy beaches to a wide extent. Among the structures exposed to the fury of the winds was a pier 2,100 feet long reaching seaward from El Segundo California A year before this wharf had been 4 100 feet long but substantially half of it was then carried away by the waves during a violent storm The structure was then so racked that it was not in a condition to withstand an attack of even lessened severity, and yet its maintenance was quite vital to the continuance of certain important shipping operations It was to protect this pier from further harm that a so called air breakwater was installed and happily it was ready for service when the hour of trial came

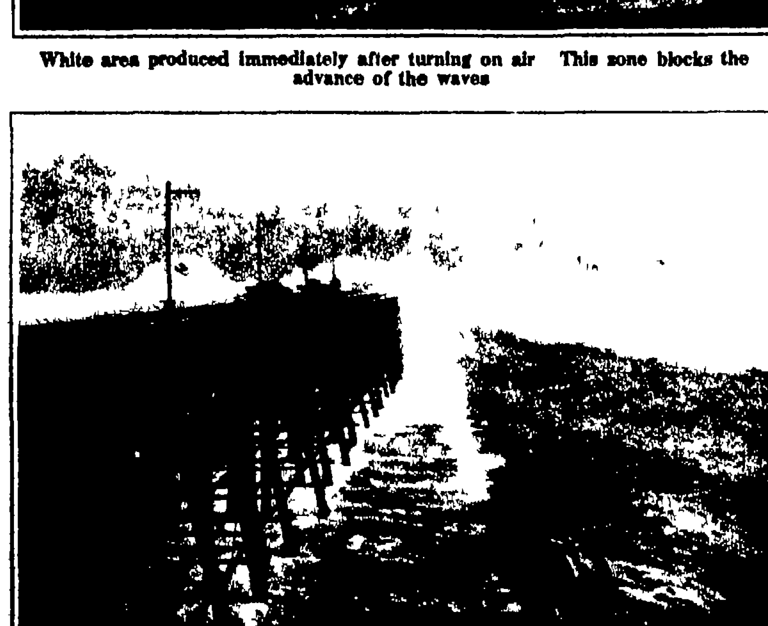
Fundamentally the equipment was decidedly simple and consisted broadly of the following essentials The seaboard end of the wharf has a width of 70 feet Parallel with this and 145 feet farther out, 4 inch piping, perforated was laid on the waterbed for a length of 120 feet Each end of this was coupled up to smaller pipe leading back to the pier and was fed by two compressors each having a capacity of 1 000 cubic feet of air per minute On each flank of the dock head was laid under water more perforated piping running parallel with the face of the pier for a distance of 100 feet thus giving a total length of 320 feet of air breakwater These flanking sections also drew their air from the two compressors and they were designed to catch any seas that might get in around either end of the outlying 120 foot section

When the storm came that was to put the installation to an exacting test the waves had a height varying between 12 and 15 feet, and were undoubtedly of ample size either to have wrecked a part of the dock outright or to have racked it harmfully The pier was a costly structure and the owners might profitably have spent a good round sum to insure its security During the worst of the storm and as long as the waves were big enough to threaten harm, the two compressors were kept going This was for a period of 23 hours, and as the air bubbles rose surfaceward from the perforated piping they served to blast the billows or to be more exact, to destroy the wave motion of their masses As a result the rollers seemed to drop as if their foundations had been knocked out from under them and the remaining motion lacked sufficient surging force to disturb the supporting piles among which they eddied as they spent themselves in their shoreward travel



White area produced immediately after turning on air This zone blocks the advance of the waves

The compressors were located something like 2 miles away from the break water, and allowing for leakage en route, it is probable that not more than 1 500 cubic feet of air was available for service at the perforated pipe Under normal conditions, the air pressure need not be but a trifle in excess of the hydrostatic head, in this case the pipes were laid in 30 feet of water, but it so happened that the compressors at El Segundo were for much higher pressures and, therefore more expensive to run This added needlessly to the outlay, and yet for the 23 hours of continuous service the cost amounted to only about $90 Surely this was a very modest price indeed, to pay for the saving of that pier



Great 4100-foot pier at El Segundo, Cal.
Half of this wharf was swept away by the storm blowing when the photograph was taken. It is now protected by an air breakwater.

German Twine and Yarn Made from Paper

AS Germany has been unable since the war to import in sufficient quantities the raw materials used for making twine and string, German manufacturers have turned to the production of these articles from paper and have succeeded so well that they now appear upon the market Paper twine and paper yarn can not be said to be novelties nor products of the war, as Japan manufactured yarn and textiles from paper pulp over a hundred years ago, America some 60 years ago, and Germany since 1890 The products resemble those made from jute or hemp

Strategic Moves of the War, April 7th, 1916

By Our Military Expert

WHEN mention is made of "The Ring of Steel" about the Central Empires, with but one mode of egress Asia Minor, no intimation is intended that these empires have any desire to effect an escape from anything The ring of steel is an arbitrary term which designates the position of the battle lines and the limits of neutrality which for all purposes of activity from within or without supplement the former in the formation of the enceinte of blockade

Lest there arise an erroneous opinion of favoritism it may be well to add that there are two distinct ways of looking at the situation, and as matters now stand both views are correct To simplify discussion however the situation as mentioned in these lines will be referred to generally as "The Blockade" And the two points of view are as follows

The Entente "Teutonia is completely enclosed now throughout the extent of its allied territories by powerful battle lines wherever there is free field for operation, with the exception of the Asia Minor peninsula And there the armies of the Caucasus are steadily driving onward to set the last link in the chain"

Teutonia — The Entente has tried at every point to break a way into our possessions and not only has every attempt failed, but we have wrested territory eventually from each attempt and are now holding the whip hand As for the army of the Caucasus—it will not be difficult to hold the Asia Minor peninsula"

It boils down to "Germany can not get out"—"The Allies cannot get in."

Examination of the map will disclose how, in effect, the territory of the Kaiser is isolated from the rest of the world so far as the acquisition of supplies from the exterior is concerned

Take Nieuport, on the Channel, as an initial point The English French battle line establishes a so-far unbroken barrier to the Swiss frontier The neutral barrier extends to the beginning of the Italian battle line —and neither belligerent seems disposed to poke the Swiss hornet's nest From the head of the Adriatic control of the sea rather than a neutrality line forms the barrier And even if the Italian fleet is not predominant in the Adriatic, the Strait of Otranto is blockaded by the Allied fleets. A tiny corner of Albania forms a link in the battle line, then the pseudo-neutral frontier of Greece interposes until the lines of Saloniki are encountered And the coast, eastward of the Saloniki position past the mouth of the Dardanelles and down the Palestine coast is under the guns of the Mediterranean fleet of warships

Start again from Nieuport The Belgian coast is under blockade The line of neutrality loops about Holland, which country, reports now state, is seething with latent activity, directed no one knows where as yet From the northernmost point of the Netherlands the British fleet, by means of innumerable patrols, blockades the bight of Heligoland to Denmark A neutral coast and the blockade is again effective across the Skagerrack, enclosing the Cattegat and the Straits The line of neutrality then follows the Swedish shore of the Baltic and the Gulf of Bothnia to Finnish Russia Germany controls the Baltic with its communication through the Kiel Canal to the North Sea But at Riga the Russian battle line begins, to extend with slight variation almost directly southward until the Roumanian frontier is reached Again doubtful neutrality requires that the enclosing line loop itself along the Austria Hungary borderland, along the eastern edge of conquered Serbia along the Bulgaria Roumania frontier, where troops are massed on either side in anticipation of trouble Russia controls the Black Sea, so the blockading line justly faces the shore of Bulgaria and Turkey, past the entrance to the Bosphorus and along the Black Sea coast of Asia Minor to a point some miles west of Trebizond As the Baltic is virtually a German lake, so the Black Sea is Russian.

From east of Trebizond the Russian Army of the Caucasus under the Grand Duke flings itself forward in a loop toward Sivas, then back to south of Lake Van, thence southeast in broken array until it crosses the Persian border, its tip feeling for the not distant Persian Gulf

At the present time this Russian Army in Asia Minor establishes absolutely the only moving element in the line of battle, the only force, excepting the troops which oppose its progress, engaged in strategic maneuvers throughout the theaters of war and the object of its advance is the sweeping of Asiatic Turkey and the closing of the blockading ring

Comparatively speaking, there is little in the way of supply that can enter Teutonia from Asia Minor Mineral wealth is there undoubtedly, and a certain amount of food supply, but scarcely enough, under the disturbed conditions existing in Turkey to more than supply the immediate needs of the Ottoman Empire

Teutonia's strategic advantage of interior lines is clearly evident from the map At will the forces of the Kaiser can be shuttled back and forth on defense or offense from east to west or vice versa even to the southward through the Balkans to Asia Minor, on the other hand, the two great elements of the Entente, England France and Russia are absolutely separated from each other for all purposes of combined movement. One side cannot reinforce the other in time of reverse or threat, Teutonia seems—and is—a cohesive unit not only through arbitrary political affiliation, but territorially as well, and the military advantage is a tremendous one.

Morally, the loss to Teutonia of Turkey in Asia by no means an impossibility or improbability, would be severe, tactically, its severance from the Central Empires would seem to be a net gain, for, in view of the inherent responsibility for defense of the present long line in faith to the Turkish ally, its defense requires men, many men, not only for the actual line of battle, but for the operation and defense of the long and tenuous line of communication To the Kaiser, could the neutrality of Roumania be assured, the most ideal line of frontier in the present war, for defensive purposes purely, would extend from the western tip of Roumania, across Serbia to the Adriatic The now far flung line would then be contracted until a minimum of men could defend it, the railway service of rapid communication would be at its zenith of effectiveness and the twin empires, Germany and Austria Hungary while practically besieged, would still maintain the severance of their enemies, possess the most feasible interior lines and really begin to fight.

It must be evident to all that the real, bloody, cheek by jowl war has not yet begun, nor will it as long as present conditions exist—that is, without an unlooked for break in the lines or the interposition of a new neutral force athwart a dangerous sector The Kaiser's present position is one of territorial gain, with which he is properly anxious to bargain for peace; the German (Austrian, etc.) line of defense proper lies well back of the existing lines, along the storied Rhine and the Vistula—Carpathian front. And from the expressed determination of the Entente the time may come when it must be assumed through the steady loss of men, which has averaged about six per cent per month of the entire force afield, and the consequent safety-factor necessity for contracting existing lines. When such a condition occurs the real fighting must begin unless some agreement for peace has been reached.

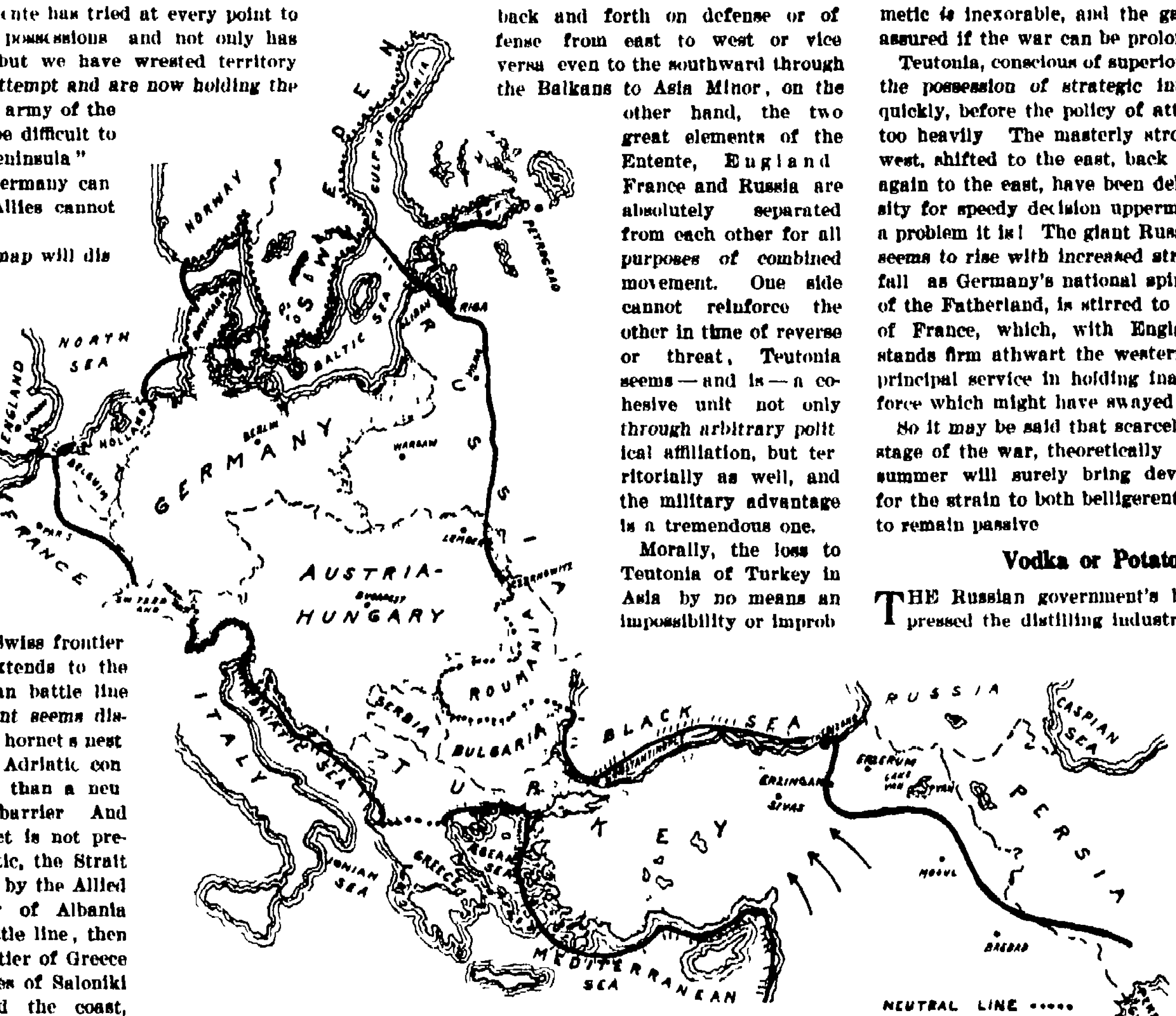
Arithmetic is inexorable. No one, pro-Ally or pro-Teuton, can deny that if the war lasts long enough and pawn, bishop, rook and castle are exchanged, man for man, the two-to-one advantage of superior numbers must tell And no one, either, will deny that the military organization and cohesiveness of the Central Empires is superior to that of the Entente, for from the standpoint of the Teuton, the military spirit has been the guardian of German institutions and has been scientifically developed as such.

It brings the situation to this:

The Entente, while as unwilling as Teutonia to sacrifice a life or squander a dollar of national fund for mere war, is playing the game of attrition—for arithmetic is inexorable, and the gaining of its end seems assured if the war can be prolonged sufficiently

Teutonia, conscious of superiority of organization and the possession of strategic interior lines, must win quickly, before the policy of attrition can begin to tell too heavily The masterly strokes that began on the west, shifted to the east, back to the west again, and again to the east, have been delivered with this necessity for speedy decision uppermost in mind, but what a problem it is! The giant Russia, Antaeus of nations, seems to rise with increased strength from each heavy fall as Germany's national spirit, in fear for the fate of the Fatherland, is stirred to its roots, so too is that of France, which, with England's tremendous aid, stands firm athwart the western way Italy lends its principal service in holding inactive a great Austrian force which might have swayed the balance elsewhere

So it may be said that scarcely more than the initial stage of the war, theoretically has begun, the coming summer will surely bring developments of moment, for the strain to both belligerents is too great for them to remain passive



The iron ring around the Central Powers

Vodka or Potato Flour?

THE Russian government's ban on vodka has depressed the distilling industry and consequently reduced the demand for potatoes The farmers plan to restrict the potato acreage and will, of course, have to arrange a new rotation of crops

The Russian Department of Agriculture is anxious to maintain the potato industry and point to the example of Germany in developing new uses for potatoes The Germans began ten years ago to build potato-drying mills and had built 500 of them before the war began What the number is now, considering their great shortage of grain, is difficult to estimate, but it must be great.

Potato flour mixed with wheat or other grain flours makes a nourishing bread, the present military loaf of Germany, in fact. Furthermore, the coarser flour or potato bran makes excellent stock food. The Russian farmer, deprived of his distillery market for potatoes, might be induced to dry the crop and grind it into flour—especially in war time—if he can be convinced that the machinery is not too costly The big German dryers have a capacity of 20 tons per day and cost as much as $12,000 to build. This is too great an initial expense for Russian needs. Recently the Department of Agriculture has shown that ordinary starch dryers costing only $500 or $1,000 are quite satisfactory as potato dryers. The actual drying costs only one eighth of a cent per hundred pounds of raw potatoes. About 30 per cent of the raw weight is obtained in the dried form so the cost of the product is less than half a cent per hundred pounds. The cost of grinding this into flour is about double the above and premiums are now offered for devices that will cheapen the process.

Possibly the prohibition of vodka will stimulate resourcefulness in the Russian farmers.

War Game—V

Frontal Attack

By Guido von Horvath

THE development of a combat should enable the commander to decide when and where to deliver the decisive attack.

When we speak of a frontal attack, we mean a direct advance against the enemy line Superiority in numbers, heavier fire, and the culminating shock of the final assault, give the decision At the start, the advantage is with the defenders, and such an attack is difficult to push home.

In actual warfare, a direct frontal attack is rare, both because it is difficult and because of the great losses which it imposes upon the attacking forces. Therefore, it will occur only under circumstances where no other means to force a decision are at our disposal The frontal attack may occur when a quick decision is demanded, or where the terrain favors it, or when armies have settled down to trench warfare, and the whole front is covered in such a way that the frontal attack may provide the opportunity for other decisive tactical movements.

The reason the frontal atack is chosen as the subject [illegible] the present problem is that this a[illegible]one of the simplest tactical m[illegible]t its development will [illegible]actics which will enable us [illegible] problems.

In the previous War Games, we have taught the general principles by the solution of the problems, from this point we shall have the direct action To do this, we shall need the map as representing the terrain of the field of operations, the conventional signs representing the troops drawn to the scale of the map, and the perspective to help us visualize the terrain By these means, each particular phase of the combat can be carried out in a manner to bring closer home to us the meaning of war and the necessity of preparedness

The map enables us to measure our distances accurately When we have the distances, we can determine the time necessary to place the various troops in their proper positions. To avoid mistakes and to guard against unintentional slips stick pins should be used to locate the forces on the map. The error of a small distance on the map represents a considerable distance on the ground and may mean the difference between success and failure in the development of the combat.

We can now return to the Blues, Colonel K.'s detachment, at the moment when the last game closed The situation is given in the accompanying map This map will also be useful for the location of the troops, which will work out the future problems.

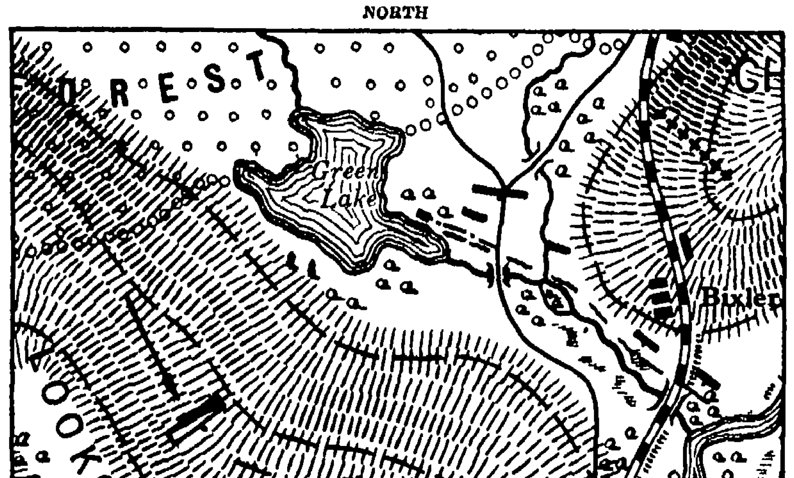
This situation represents the phase of a frontal attack at a distance of 1,000 yards from the enemy Undoubtedly, the appearance of the Red cavalry at this moment, and their surprise attack on the left flank of the Blues, is a development of great importance, and must cause several changes in the action It will be remembered that Colonel K. has given orders *not to attempt* an assault against the enemy's left flank, but to hold the edge of the forest. It is evident that the commander, directing the attack from Argus Farm, expected the possible coming of the enemy on the left, but that he lacked the time to forestall the disaster to the troops guarding the left flank.

To represent the situation, place signs on the map showing the location of all the Blue troops when at a distance of 1,000 yards from the enemy Then locate the defensive line of the Reds. Last, the two attacking squadrons of Red cavalry just overwhelming the left flank of the Blues.

With his staff at Argus Farm, Colonel K. has started the action, and is now watching its development. He must have his eye not only upon the ensuing combat, but also upon everything else which may happen. Either he or one of his staff will carefully search the edge of Lebanon Forest through his field glass. The flank guard commander has undoubtedly sent patrols ahead, but the Red cavalry, with its rapid advance, has made the patrol service useless At the moment when the enemy squadrons break from the edge of the forest, Colonel K has to take counter measures against the attack of the Red cavalry on the left flank, or it will prove disastrous.

Bird's-eye view of region mapped below, looking toward the south

NORTH



Enlarged map of the vicinity of Lookout Hill

The forces which Colonel K can immediately utilize are his artillery and the reserves behind the left flank Well trained troops, in circumstances like this, can act very quickly All that is necessary is the proper order and counter action will follow The order should be to fire on the cavalry on the left flank The reserve battalion would have to form a firing line to the left and as soon as the enemy arrives within effective range, he should be met with a withering rifle fire

The action of the artillery is even quicker The range and target are known The battery, or a part of it, would have to change front to the left. Even before the infantry could fire, shrapnel would be bursting over the Red cavalry The Reds would have to turn, and probably pay heavy toll for the destruction of the left flank guard.

These changes in the situation should be indicated by changing the troop signs on the map

So far we have not gone further than to consider the enemy cavalry alone We must know that the Red commander will be aware of the change in the situation as soon as the Red cavalry appears on the scene He, too, will have to act and his duty will be to make the best of the favorable change and to utilize the moment to the best of his ability

Naturally, his first movement will be to direct his infantry fire, and especially his artillery fire, in such a way that his own cavalry will benefit by it This can be done in two different ways either by increasing the fire along the whole line, or by directing *a fire against that portion* of the enemy forces which are threatening the cavalry

It is very easy to realize that if the Red artillery will shell the left flank of the Blues the troops there will have to suffer severely while warding off the blow directed by the Red cavalry

It is assumed that the Red cavalry will have to withdraw but it is evident that the left flank of the Blues was seriously shaken.

Colonel K will have to send out a new *left flank guard* This is immediately engaged with the now dismounted Red cavalry The *fire* combat *rapidly* develops and its volume assures Colonel K that considerable forces are involved Whereupon, having in mind his original mission to hold the bridges for the advance of the division he now decides to draw back the left of his firing line and to remain on the defensive on the crest of Lookout Hill with a left flank guard on the highest point

It is now 4 P M and early summer

As soon as he learns of the partial withdrawal of the Blues the commander of the Reds now reinforced by one regiment of cavalry finds the time right to assume the offensive A study of the map will make it evident that, as things now stand, the Red offensive must also be a frontal attack This movement will be a very difficult one for Lincum Creek is just deep enough, at this season of the year, to prove a very serious obstacle Therefore the Red advance must be made by way of the bridge or by boats if any *are available or by the remnants of the* destroyed railroad bridge

There is the chance to use the cavalry on the right flank to commence the attack, and under cover of the cavalry action to throw the infantry gradually across the bridge As a matter of course it may be expected that the Blue artillery will shell the bridge and endeavor totally to destroy it by its fire This artillery fire will cause great loss to the Red column, forcing the passage of the bridge

The reason which decides the Red commander *to order an attack* which will necessarily cause many casualties is his desire to force a speedy and probably favorable decision With the arrival of the reinforcing cavalry regiment his forces are numerically superior In addition the moral effect of the cavalry attack although unsuccessful and the partial retirement of the Blues on their left flank is greatly in his favor His chances therefore are fairly good for a decision in his favor

The difficulties in the way of the infantry advance must be overcome by the skillful and judicious use of artillery For instance the crossing of the creek will be very *difficult* To overcome this the Red artillery must direct its full fire on those Blue forces which are trying to prevent this crossing If the artillery does its work cleverly, the crossing can be accomplished without too great a loss.

Before the infantry can attempt the decisive assault, it must approach close to the enemy, and it must gain fire superiority Then the use of superior forces and

(*Concluded on page 400*)

The Motor-driven Commercial Vehicle

Conducted by VICTOR W PAGE, M. S. A. E.

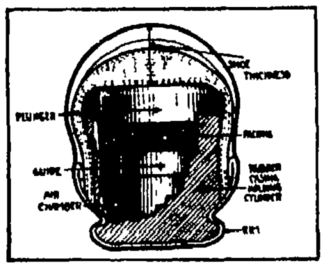
This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles

Cushioning the Truck Tire

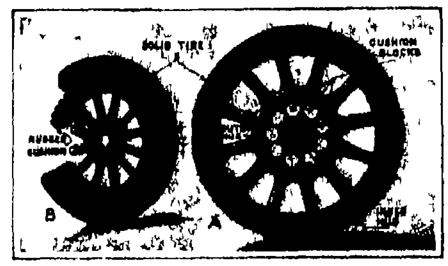
WHILE no form of tire has ever been devised that can displace the air filled form almost universally used on automobiles of the light and medium weight classes, inventors are giving the problem of a puncture proof, yet resilient tire considerable attention. One of the latest devised is illustrated in the sectional view herewith though this is said to be more suited for trucks than it is for pleasure cars on account of its weight. The shoe has an extremely thick tread and is said to give considerably more mileage than the ordinary form on account of this extra material. The usual form of inflated inner tube is replaced by a series of steel cylinders in which a fixed air pressure is maintained by movement of the wheel over the road. Each cylinder is provided with a guided piston or plunger which compresses the air in the cylinder as the piston moves in from distortion of the shoe when an obstruction is passed over. The cylinders are imbedded in a ring of rubber as indicated so that they cannot be displaced. The rim is a special form and the tire must be installed by special machinery. It is made in popular sizes.

The solid rubber tire is the most enduring and practical for commercial vehicle use, but it has the disadvantage of lacking resiliency which causes vibration of all mechanical parts and tends to loosen the various fastenings throughout the chassis. This factor of vibration becomes more severe as the vehicle speed increases so on relatively high speed trucks, as used in fire department service, special forms of wheels incorporating a cushioning element distinct from the solid rubber tire are fitted.

Two forms of cushion wheels are shown herewith. That at 'A' has a peculiar double hub formation in which cylindrical blocks of rubber are placed in semi-circular bed spaces between inside and outside hubs these acting as driving members as well as cushioning elements. As the rubber is not subject to depreciation due to contact with the road, as the outer solid tire is, it can be of very resilient composition. The wheel at B operates on a similar principle except that the cushioning element is carried out near the rim. The solid tire is carried by the outer rim, which rests upon the special soft rubber cushion interposed between it and the wheel felloe. This cushion is inserted between the wheel parts under pressure and there can be no sliding around of one rim relative to the other. The inner and outer rims are joined by rings of tough rubber compound one on each side, which act as walls to keep grit, water and other foreign matter out of the chamber or annulus in which the rubber cushion is carried.



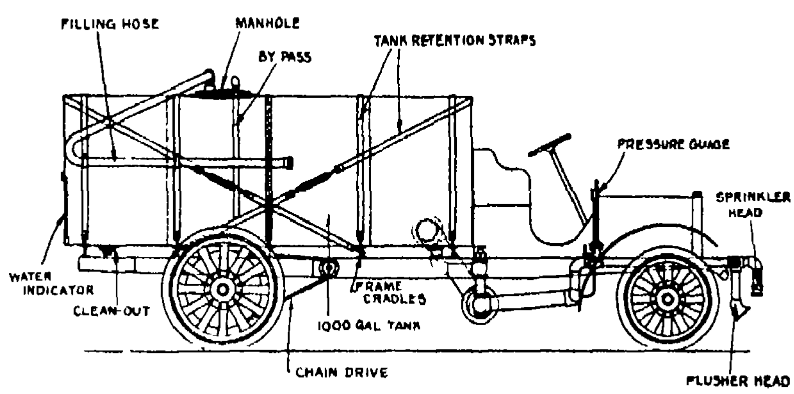
Combined pneumatic and solid rubber tire



Cushioning solid rubber tires with resilient pads and blocks

Motor-Driven Street Cleaning Outfit

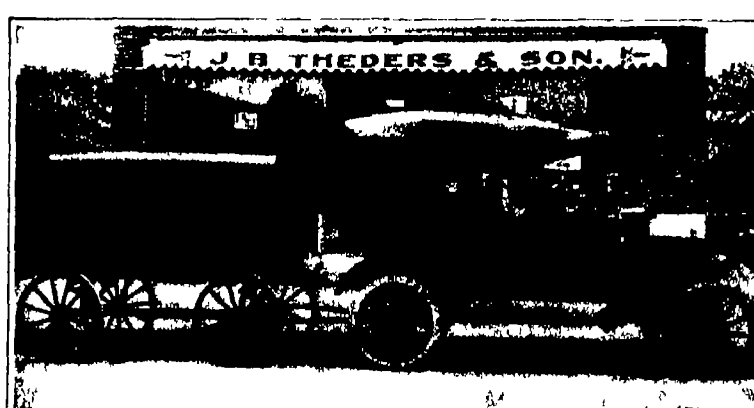
THE combined street flusher and sprinkler illustrated is mounted on a 5-ton chain-driven chassis and while the chassis incorporates novel features we will confine ourselves to a consideration of the flushing apparatus because most municipalities are interested in the method of street cleaning by flushing since this vehicle type has demonstrated that it is capable of doing the work satisfactorily. The tank, which is about 12 feet long is made of 3-16-inch boiler plate and is galvanized inside to prevent any rusting of the metal. The tank holds 1,000 gallons and a by pass is fitted so that when the tank is filled it is not possible for the water to overflow through the filler opening at the lower end. The top of the tank is provided with a manhole of standard size and baffle plates are fitted to prevent surging of the large mass of water as the truck moves. A strainer is provided in the outlet to insure that only clean water will reach the pump. The tank is round in section and is mounted on six metal cradles. These cradles or bed members are clamped to the frame of the chassis by U bolts and the tank is held in place on these cradles by substantial straps of metal. The tank is also braced against fore and aft movement by strong bands and turnbuckles as indicated.



Street cleaning machine combining sprinkling and flushing functions

For flushing more pressure is needed than is available by utilizing the flow due to gravity. A centrifugal pump is used to obtain the desired water pressure. This is mounted concentrically with the main propeller shaft and is actuated by a positive jaw clutch from the propeller shaft itself. One of the clutch members is so mounted on the shaft that it can be easily actuated from the driver's seat so that the pump may be put into action, when desired. At normal engine speeds the pump has a capacity of from 250 to 350 gallons per minute at from 20 to 60 pounds pressure. A flushing head is located ahead of each front wheel and these heads are adjustable so that the water supply can be pointed to either side of the truck and the heads used in conjunction to either side or one pointing to one side while the other may be directed as desired. It is also possible to have the right hand nozzle point towards the left and vice versa as a cross stream is said to be the most effective cleanser under certain conditions. By working at high pressure it is found that considerable flushing may be done with a comparatively small amount of water.

The sprinkler heads are situated directly in front of the flushing nozzles and are on the end of a pipe pointing toward the ground. The amount of water delivered by the sprinkling heads can be varied from 10 to 80 gallons per minute. It is said that with both sprinkler heads in operation a street 80 feet wide may be sprinkled satisfactorily with one passage of the truck. All of the controls are placed convenient to the driver, who can open or close either the right or left hand supply pipes or both and can vary the supply of water and its pressure as he desires. The operation of the pump is controlled by a lever in the center of the chassis, near the driver and a small pressure gage on the dash shows the pressure of water supplied from the pump. This can be increased by either varying the speed of the motor or the speed of the truck.



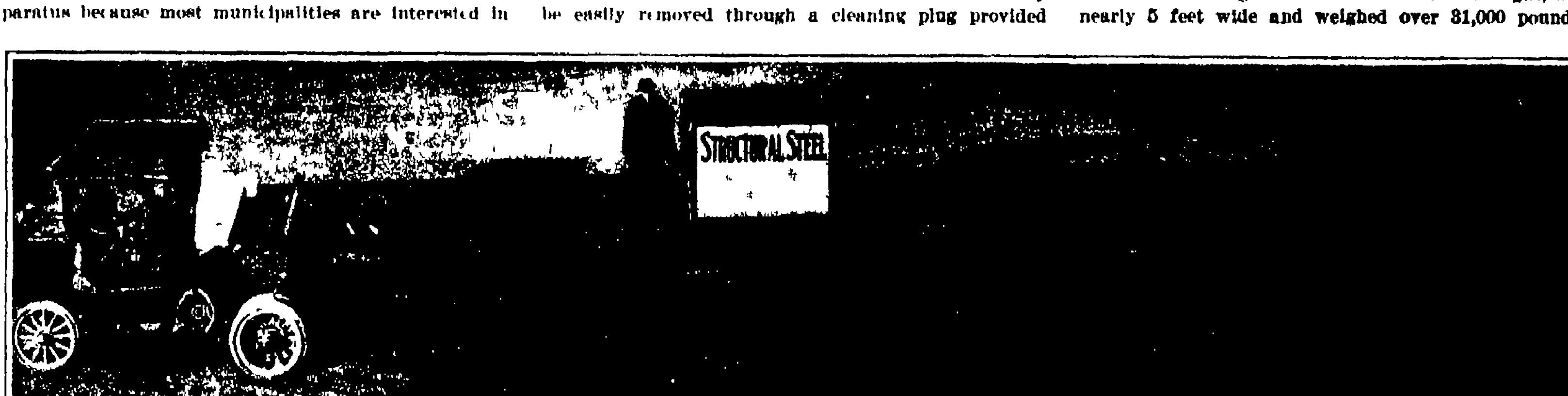
Light rubber tired trailer for attachment to passenger cars

It will be apparent that this is an advantage of some moment because there are many parts of the chassis mechanism that would not be benefited by continual baths of water. An indicator is provided at the rear end of the tank to show the exact height of the water.

It will be observed that the tank tilts towards the rear of the chassis so that any foreign matter in the water will flow in that direction. The sediment may be easily removed through a cleaning plug provided

Moving Structural Steel With Tractor

ANYONE who is familiar with the problems involved in moving heavy structural steel girders will appreciate the task accomplished by the tractor shown in the accompanying engraving. This illustrates one extreme of the great range of usefulness of the mechanical horse. The steel girder measured 60 feet in length, was nearly 5 feet wide and weighed over 31,000 pounds.



Utility of gasoline tractor in moving heavy structural steel girder

This formidable load was hauled a distance of over 3 miles to its destination in 18 minutes, and no trouble was experienced in stopping the heavy load when desired This was due to the fact that the tractor was equipped with powerful hydraulic brakes acting on the rear wheels in addition to the large service brakes which are fitted to the jack shaft. It is stated that the load was brought to a complete stop in a third of its own length when running at its average speed of 10 miles per hour

Light Trailers for Passenger Cars

THERE are numerous occasions when the owner of a passenger car could employ it to advantage in his business were it not for the fact that in many lines the carrying of goods mars the finish of the paint and upholstery and at the same time the average touring car or roadster is not very well adapted for carrying anything but the live freight for which it was designed A plumber or carpenter, for instance has to handle bulky materials and use supplies in his work that are not of a nature to be easily handled in a pleasure car body Numerous light trailers have been designed for attachment to the rear of passenger cars, these usually being of the form that will track with the two car wheels and swing around corners when desired The outfit outlined is a practical one that is used by a grocer and it will be apparent that the bulkier goods, such as bags, barrels and boxes that could not be conveniently placed in the touring car tonneau can be carried without difficulty in the trailing vehicle Such a trailer is well adapted for the use of contractors, plumbers, painters and others, as it can be left at the job with the supplies and the car used for visiting other operations These trailers are built more substantially than horse-drawn vehicles and are usually provided with rubber tires and easy riding springs Many occasions will suggest themselves where such a trailer would be an inexpensive and very useful auxiliary to a passenger car for pleasure purposes as well as the more utilitarian business service

Motor Truck Queries

C S writes Will you please discuss briefly the following 1 Would a high tension magneto give a better spark on a two-cylinder tractor if it had a distributor so as not to spark in both cylinders at the same time? 2 What determines the length of piston stroke? 3 What does length of stroke have to do with power and economy of operation? 4 Does the best speed for a motor bear close relation to the length of stroke? 5 Why does the length of stroke vary so much in different engines? 6 Is a wide drum a good manner of tractor drive? How do they provide for turning?

Answer 1 Yes 2 The length of piston stroke is determined by various considerations of design, the most important being the desire not to exceed a safe piston speed 3. It is said that a long stroke motor is a more efficient type than a short stroke of equal bore because it utilizes the expansive power of the exploded gas charge better A long stroke engine is also a better "pulling" engine than a short stroke form as it will deliver more power at slow speed 4 The accepted safe piston speed of a thousand feet per minute has been greatly exceeded in recent years without serious consequence Some racing engines have two or two and a half times this piston speed For traction engines and for heavy duty power plants it is probably well not to exceed a limit of 1,200 feet per minute. This would limit an engine having a 6-inch stroke to 1,200 r p.m. 5. This is due to individual opinions of various engine designers. 6. Traction engines using a wide drum for driving purposes have given satisfactory service, it being said that this form distributes the load over a larger area and makes it possible for the tractor to work on soft ground. In some tractors, the drum is really composed of two of the same size, mounted together on a common axle but driven by independent driving gears. Some form of free wheel clutch can be used to drive only the drum that is on the outside of the curve and declutching the inner drum In other forms, turning is accomplished by the drums slipping

The Reversion to Shields in Warfare of To-day

WITH the advent of firearms it was believed several centuries ago that the day of armor and shields was over for all time for the powerful impact of projectiles discharged from even the early muskets rendered ineffective the light steel then worn Prior to the present war infantrymen were not provided with shields of any kind as a protection against the rifle fire of the opponent It was rather in methods of concealment, such as uniforms whose colors tend to blend with the surrounding landscape, and scattered formation that protection had been sought.

The present great war has ridiculed so many generally accepted principles of what has heretofore been considered modern warfare that the reversion of the soldiers to shields and armor does not come as a surprise At first, the shields were of small dimensions and used solely in trenches, in order better to resist the rifle fire of the enemy Such shields in most instances were provided with a slot of just sufficient size to accommodate a rifle or machine gun

Not content with employing steel shields in the trenches, the fighting forces have extended their use to infantry attacks, in order to lower the terrible toll collected by the rifles and machine guns Most of the nations now fighting in Europe have provided a portion of their men with small, individual shields which can be conveniently carried and readily erected to afford a fair degree of protection to their user Such shields are especially suited to the requirements of sappers, who must sometimes advance to the barbed wire entanglements of the enemy and cut them with a pair of pliers or other tool before the infantry can undertake a charge Lying prone behind a small portable shield, the sapper is protected to no little extent against the fire of enemy sharpshooters as he goes about his work

In some of the battles that determined the fate of Russian Poland and the great fortresses forming the western permanent bulwark of the Muscovite empire the troops of the Czar employed steel shields mounted on wheels One of these shields appears as the cover illustration of this issue, which has been painted from an actual photograph of the device The Russian movable defenses, for such they are in reality, consist of heavy slanting steel plates mounted on two large wheels, with small plates hinged at the bottom in such a manner as to protect the lower limbs of the marksmen and yet permit of the forward movement of the shield even over rough ground A metal framework in the rear, provided with four small wheels, completes the miniature fort From the photographs that have appeared, it is deduced that the Russians have given considerable thought to the design of the movable shields, in no wise can they be considered in the light of make-shifts hastily improvised by the soldiers themselves

If the number of Russian movable shields captured by the Germans is to be accepted as a criterion of their military value, it must be admitted that they have proved a failure And this seems quite logical for, while a single marksman may be protected by a small shield against rifle and machine gun fire, a shield of the size used by the Russians invites accurate, concentrated artillery fire as well because of the mark which it presents. While it is undoubtedly effective against light-arms fire of trench defenders, it cannot hope to withstand shell fire As a further consideration, the very greatness of the Russian shield makes its rapid movement impossible, so that in the event of a powerful and successful counter-attack by the enemy, its defenders must needs leave it behind in their retreat This is probably what has occurred in the majority of cases in which they have been captured intact by the Germans, barring, of course, those found at the supply bases

We may draw the conclusions that individual steel shields can be used to good advantage, but larger shields, because of their huge proportions are not a success. Protection against light arms and artillery fire during an attack in the open remains a matter of concealment or partial concealment, with each man taking advantage of such cover as he can find rather than the providing of movable steel defenses

The Current Supplement

A TIMELY article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No 2102, for April 16 is *Large Naval and Coast Defense Guns*, in which an authority on the subject tells how these monster weapons are built and tested It is fully illustrated with photographs taken in the Government shops A paper that will be found of general interest is *Economy in Study* It is the first of a series of articles by a well known writer on the subject that will be of great value not only to every educator but to every student as well presenting as it does an intimate analysis with a view to economy of effort and the securing of the best results *Animals With Many Eyes* tells of the curious and wonderful organs found in many of the lower orders of life It is accompanied by a large number of illustrations *The Paper Textile Industry* discusses many applications of paper as a substitute for other forms of fibers, with notes on methods of manufacture *Oiling Earth Roads* discusses a feature in road making that will appeal to a large portion of the public, and it will be found of especial value to the engineer *The Care of the Feet* will appeal to everyone, as it is intimately connected with our every day comfort and efficiency It is illustrated by a number of cuts Radium has been employed very widely in the treatment of a number of diseases, but many who are using or experimenting with it are oblivious to the serious dangers that are incident to its handling and which are constantly present To these *Injuries Due to Radium* will be of vital interest as it discusses a number of actual typical cases Other articles worth reading include *Indian Music Detonating Submarine Mines by Electricity* and *Engineering in the Navy*

Extensions of Time in Patent Cases

SINCE the commencement of hostilities in Europe, practically all the foreign countries have enacted remedial laws which extend the time for the filing of papers and the payment of fees in connection with applications for patents but in most cases citizens of the United States cannot take advantage of these new laws because of the failure of Congress to consider favorably the bills which have been introduced granting reciprocal rights

American inventors have not felt disposed to abandon their rights to patents in Europe for terms of 14, 15 or more years, merely because business conditions might make it difficult to introduce their inventions commercially in Europe during the first year or two of the patent term But the delays in delivering foreign mails and sometimes the impossibility of having patent work attended to promptly in the countries at war because many patent attorneys and clerks are at the front have in many cases made it impossible to file applications and pay fees within the periods prescribed by the general laws In such cases petitions to file papers and to pay fees under the new or war provisions, have met with the reply that the request will be granted provided the United States will enact laws granting similar courtesies to citizens and subjects of foreign powers It will, therefore be seen that the new law, set forth in the bills now before Congress should be enacted, not only in a spirit of justice to foreign inventors who, while at the front, are unable to attend promptly to their patent business, but also to enable American inventors to obtain necessary extensions for the protection of their rights.

LEGAL NOTICES

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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

HEEL PLATE—T J CARROLL and M H KANE Address the former Clifton Ariz Through the medium of a non puncturable heel plate disposed and secured at the interior of the shoe the heel of the wearer is protected by this invention from the frequently protruding nails of the ordinary boot or shoe including oxfords The invention also provides for the effective fastening of the covering or padding in the heel of the interior by means of the improved heel plate which overcomes the failure attending the use of adhesive material.

SPINE ARCH SUPPORT—E PACKER care of M Packer 2114 Kent St, Los Angeles Cal This invention relates to a support for the arch of the spine so as to support the human body from the small of the back to a point just above the waistline, and thereby give support to the curvature of the spine, whereby a person will stand erect with the greater ease walk with more comfort, sit straight and breathe more deeply

DETACHABLE BUTTON—T S LEITH 601 Bay St. St Paul, Minn More particularly the invention relates to a button having an arrangement of resilient shanks and a form of co-acting button head the parts being so formed and arranged that the turning of the button head through an angle relatively to the shanks will serve to bring engaging members of the shanks into position to be entered or withdrawn from the button head

DRESS—LENA KISELGOFF 133 Mercer St New York, N Y An object here is to provide a construction in which a plurality of pockets are provided without injuring the appearance of the garment. It provides a dress wherein the skirt portion is folded and connected together in such a manner as to provide one or more open pockets and a secret or hidden pocket

Electrical Devices

BURGLAR ALARM—J CHANKIN, 1050 Hoe Ave., Bronx, New York, N Y The invention relates more particularly to the circuit closing part of the alarm It provides a device which may be easily and quickly secured to a window or door and which will automatically close the electrical circuit if the window or door provided with the device is tampered with

Of Interest to Farmers

THRESHING MACHINE—E. D RICHARDSON, Cawker City, Kan An object here is to provide an improved straw rack associated with an arrangement of chaffer Another object is to provide a threshing machine with means for increasing the beating action or agitation of the straw hay and the like during its passage through the machine

BROODER—P SULLIVAN care of C F WEMPLE, Waverly, Ill This inventor provides a brooder arranged to permit convenient collapsing and storing during the winter, and when set up and used to insure the production of a uniform heat within the brooder for keeping the chicks warm prevents the chicks from unduly crowding and smothering one another provides a runway for the same and prevents obnoxious gases from the lamp from reaching the chicks.

Of General Interest

TELESCOPIC TOWER—F E WINN, care of Southern Brazil Lumber Co Tres Barras, Parana, Brazil. This improvement relates to poles or towers which may be used for many different purposes, and the main object thereof is to provide a pole or tower constructed of a

TELESCOPIC TOWER.

plurality of sections telescoped one within the other in such manner as to provide a non leakable joint therebetween in order that the tower may be extended to any desired height within its limits by means of water steam or other fluids and be certain of maintaining the same at the adjusted height

FLUID FEEDING DEVICE—H A SCHEUPLEIN 2nd St and Montgomery Ave, Bayside, L. I N Y The primary object in this case is to provide means for effecting and regulating the discharge of a fluid from an inverted bottle or a receptacle having a bottom discharge orifice in such a manner that fluid may be caused to drop or flow in the desired quantity or volume according to the various uses to which the device is put.

HORSESHOE—D S ANTHONY 413 5th Ave Sioux City Iowa. This invention relates to shoes of that type having removable calks, but more particularly to a horseshoe of that character in which the calks are carried by a plate or removable section which is fitted to and detachably fastened on the main or body portion of the shoe

PHOTOGRAPHIC PRINTING FRAME—F B YOUNG 111 Maple Ave Edgewood Park, Pa This invention has reference to improvements in plate holders and particularly to what are known as printing frames, or printing photographic holders, and has for an object to provide an improved arrangement wherein one or any desired number of pictures may be exposed at a time

BAG HOLDER—G C SHELRUD Box 56, Maynard, Minn This inventor provides a bag holder with pivoted clamps for pressing the neck of a bag against the sides of a spout, the clamps being operable by links connected by arms moving in guiding slots and held yieldingly at one set of ends by springs, these being radial rods which are pivoted to the arms, which with the springs limit the movement of the arms

STIRRUP—C A H GINN Grenada Miss. An object here is to provide a stirrup body which is adapted to be joined to the strap therefor by means of a swivel connection whereby to prevent twisting of said strap to permit of ready adjustment of said stirrup body to the movements of the rider's foot so that binding or other injury thereto will be prevented.

GLASS WELL MANTLE AND CLAMP THEREOF—S B HENSHAW, care of Charleston Window Glass Co, Charleston W Va The object of this invention is to form the glass well or drawing chamber by means of vertically disposed fire clay mantles having interengaging portions, and to provide in connection with the furnace buildings clamps engageable with the series of fire clay mantles so disposed in order to hold the same firmly together and prevent accidental displacement

PROCESS OF SUPPLYING MOISTURE TO COMMODITIES—E. L. HENSON, 744 College St., Clarksville, Tenn This invention relates to improvements in devices for supplying moisture to flour, meal bran shorts etc An object is to provide a process by means of which a substance, such as flour may have moisture supplied, the amount of moisture being accurately regulated even to a fraction of one per cent

Hardware and Tools

WIRE HOLDING STAND—J W PETRE, 241 E South St. Fostoria, Ohio One of the principal objects of the invention is to provide a stand whereby a plurality of rolls of screen or other species of wire may be kept in such a position as to be unrolled to any desired length without removal from the stand for the purposes of dispensation

SELF PROPELLING HOSE NOZZLE—J F BURNS 60 39th St Corona Long Island, N Y This inventor provides a nozzle constructed to deliver a boring jet on a line substantially parallel with the axis of the nozzle provides rearward openings, forming jets from said nozzle to propel the same by pressure against a volume of water in the rear thereof, and provides means for varying the effectiveness of rearwardly directed jets.

PLUMBER'S BENCH—N ROSENFELD, 280a Linwood St., Brooklyn New York N Y The invention provides a bench which may be folded to a diminished compass for storage or transportation provides a bench adapted for attachment to the framework of a building under construction provides means for bending pipes to obtain different curves thereof, provides a tool box for storing one or more tools of greater length than the capacity of the box would normally afford and provides means whereby various machines may be attached to said bench

TIRE BOLT WRENCH—W LARSON, R. 8 Box 10, Kingsburg, Cal The invention relates to a device for tightening and loosening nuts upon bolts, particularly nuts upon tire-bolts. It provides a wrench whereby the nut and bolt can be simultaneously engaged therewith, so that the bolt is prevented from turning while the nut is unscrewed or screwed upon the bolt.

Heating and Lighting

FLASHLIGHT BATTERY CONTAINER—H M. KORETSKY Bright Star Battery Co, 430 W 14th St., New York, N Y This invention relates to flashlight batteries of that type in which a plurality of cells are arranged end to end so as to fit in a tubular or cylindrical flashlight casing and the invention has to deal more particularly with the container for the cells Mr Koretsky has invented another flashlight battery container, which relates to a container for the cells that form the battery of a pocket flashlight It overcomes the objections in containers by providing a container which is made from a single blank, which has printed matter on its outer surface so as to take the place of a pasted label, and which when empty is folded flat to take up little space.

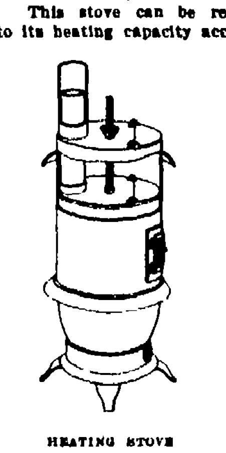
Household Utilities

BATH TUB SEAT—G H MULLER, 20 Prospect Place, Far Rockaway, L. I., N Y This invention provides a bathtub seat which may be quickly applied to the bathtub at either end or either side It provides a seat which may be folded to position against the side or end of the bathtub when not in use, whereby the same need not be removed during the ordinary use of the tub

CLOTHES LINE SUPPORT—A P FURMAN, 1337 Clay Ave Bronx N Y, N Y This invention provides a device for apartment houses which is adapted to occupy various positions of adjustment with respect to the window frame, whereby the clothes line may project within the window for the purpose of applying or removing clothes and in another position the line will be held on the outside of the window, the device including means for temporarily locking the movable parts of the device in either of said positions.

COOLER.—E. C PURNELLE, P O Box 592, Douglas, Ariz This invention provides a cooler comprising a safe provided with air-circulating and ventilating means provides a manner of securing cloth to be moistened; provides for maintaining the cloth saturated, provides a door having a member to catch any drip from the cock of the water tank when the door is open utilizes the said drip for saturating a cover provided on the door and provides a drip pan to carry off the water dripping from the saturated covering

STOVE—E E TAYLOR, 1126 S 4th St., St. Louis Mo This stove can be readily adjusted as to its heating capacity according to



HEATING STOVE

seasonal or diurnal changes in temperatures. The invention provides a device in the nature of a false top arranged within the upper portion of the stove and adjustable toward and from the fire in the fire-box so as to vary the capacity of the combustion chamber, the said false top having suitable means for adjustment, and also means for forming a continuation of the smoke flue for conducting off the smoke and gases

Machines and Mechanical Devices

LETTER INDICATING MECHANISM—W E. GRAY, 816 817 Ideal Bldg, Denver Colo The subject of this patent is an indicating device to be employed on a copy-holder and arranged to be moved across the copy by a step-by-step movement to follow each letter and space of the copy as it is written upon the typewriting machine At the end of a line when the typewriter carriage is returned to the right, the engaging member is automatically returned to the left of the copy holder and provision is made to give it movements in synchronism with the line spacing of the typewriting

RAIN GAGE—B. G PATTERSON, 1606 N Klein St, Oklahoma, Okla This invention has reference generally to improvements in devices for the purpose of catching and measuring rain fall, commonly known as rain gages, and more especially to that class of rain gages employing a double compartment tilting or oscillating vessel for measuring the water

MASSAGE APPARATUS—J SARATURO, 4757 Jerome Ave Richmond Hill, L. I., N Y This invention refers to improvements in massage apparatus, and particularly to a holding device for the vibrator, and has for an object to provide an improved structure, whereby the hand of an operator may be properly connected with the vibrator so as to give an even firm vibration.

ATTACHMENT FOR ADDING MACHINES.—H E. BROWN, Columbia Mo In this case the invention consists in providing means to indicate the appropriate numerical orders of the adding machine in which numbers should be registered, especially the numerical order of the adding machine in which the left hand digit should be registered

MACHINE AND APPLIANCE FOR CUTTING OR FORMING SCREW THREADS.—G H ALEXANDER, Doe St., Birmingham, England. The present invention comprises the use of a screw threaded mill like rotating tool having a multiple start thread of the same pitch as that required on the work piece and rotating relatively to the work piece at a rate which is inversely proportional to the number of starts on the mill. By "pitch" is meant the distance between any one ridge and the next.

DETACHABLE MAINSPRING FOR CLOCKS.—A AALSON, Redwood Falls, Minn. This improvement pertains to clocks and particularly to the springs thereof and means for holding the same in place, and the object is to provide an arrangement whereby the main spring of a clock may be removed without disturbing the remaining part of the works of the clock

CONVEYER ATTACHMENT—A. WINSKI Address Henry D. Scott, Kool, Wyo This invention pertains to endless conveyers of the type employing plates extended between the corresponding links of two endless chains, such as used for conveying coal instead of by means of buckets. These plates are frequently bent by dumping the load thereon, thereby causing open spaces between adjacent plates through which the coal may fall. The present invention overcomes the defect.

CIGAR DUMMY MACHINE.—E. BELOT, 819 Rue de Charenton, Paris, France. In machinery where the interior of the cigar is molded in the form of dummies mechanically inserted in wooden molds having cells, the work is confined to rolling the dummy and putting the same into the molds Afterward the mold provided with its lid is carried to a pressure device which is usually a screw press operated by hand. This invention provides an apparatus to apply such pressure automatically in the machine which has made the dummy so as not to stop the output of the machine

PRINTING DEVICE.—A G OGDEN, 109 S Charles St. Baltimore, Md This invention relates to improvements in printing devices, especially those devices wherein a number of prints are to be made from a single negative. An object is to provide improvements whereby a multiplicity of prints may be made on a sensitized plate in a minimum of time.

HYDRANT—G N FRASER, care of Eugene Iron Works, Eugene, Ore The invention provides an improvement in the drainage means of the hydrant, such improvement embodying a drainage plug normally closing a drain opening, the plug being provided with a drain valve automatically operable when the inlet valve is in closed position, to be opened for providing a continuous drainage from the hydrant casing.

METER ACTUATED CUT-OFF DEVICE.—N ANDERSON 11 Mesba Place, Duluth, Minn. The invention provides a device for use in connection with water meters, for automatically delivering fixed and predetermined quantities of water, and wherein the mechanism is so arranged that when it is set in operation, it will deliver a predetermined amount of water, after which the device will automatically shut off the water, and the mechanism is so arranged that the amount of water to be delivered may be varied.

GRAPPLE.—A BRYANT Route 2, No 40, Moulton Ala The present invention provides a grapple which includes resilient elements held apart by a trip mechanism which, when contacted by an obstacle, permits said elements to return to normal positions whereupon the article is securely held therebetween

PHOTOPRINT DEVELOPING MACHINE.—C C TOWNES, 2110 Main St., Baker, Ore. This improvement relates to the developing, fixing and washing of photographic positives in a purely mechanical manner and in large quantities, as for amateurs, and one of the main objects thereof is to provide an apparatus which accomplishes the above results automatically.

DEVICE FOR MEASURING WOVEN WIRE. T C RUSH Lexington Ky The invention, while capable of use for measuring sheet material generally, is more particularly constructed and arranged for measuring woven wire, and is adapted to be arranged in connection with a stand equipped with a plurality of trays or rests to receive rolls of the wire cloth of varying widths, and if necessary of varying mesh.

Musical Instruments

REPEATER.—E. S. KROGH, 122 Livingston St., Brooklyn, New York, N Y Among the principal objects which this invention has in view are To provide means for automatically replaying a disk record to diminish the time interval between the repetitions of the playing of said disk record, and to noiselessly suspend and inaugurate the playing of such record.

Prime Movers and Their Accessories

PISTON VALVE.—H J HICKEY, Fort Dodge, Iowa The invention relates generally to piston valves for steam, gas, and other engines, and more particularly to piston valves for internal combustion engines. It provides a valve arrangement whereby to decrease the noise and increase power over the usual puppet valves of the same bore and stroke, and one which will effectively operate without the formation of compression.

LUBRICATING PUMP FOR ENGINES.—F H. TREGO, care of Knox Motors Co., Springfield, Mass. This invention has for its general objects to provide a special form of pump that is mounted in the crank case of the engine, the pump being so designed as to be readily removable or assembled, of durable and substantial construction and requiring comparatively little power for its operation.

TWO-CYCLE COMBUSTION ENGINE.—C. W. ROSSELS and A. A. [illegible]. Address the

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The Rapid-Fire, "Revolver" Principle Applied to the Submarine Torpedo Tube

(Concluded from page 395)

of a submarine water-tight hull is fitted with a magazine provided with cradles bearing torpedoes and in addition to these, compressed air vessels or chambers, arranged so that as each torpedo is brought up to the launching tube L it is accompanied by a chamber containing compressed air for discharging it.

Fig 1 is a longitudinal section, Figs 2 and 3 are cross sections of the forward part of the inner or water tight hull

In these figures *ss* are torpedo storing tubes carried by radial arms or disks *RR* fixed on a shaft *a* which revolves in bearings *CC* *S* designates the torpedoes carried by the tubes *ss*, whose nozzles *M* can be made to fit into a mouthpiece *N* of the launching tube *L*, by moving forward the whole torpedo magazine or each torpedo-carrying tube in turn

By disconnecting the storage tubes from the launching tube, when a torpedo has been discharged, the revolving magazine can be turned through the angle necessary to bring another torpedo to bear in the loading and discharging position

The torpedo loading and firing device thus described and illustrated answers the main purposes desired in submarine warfare Loading and discharging torpedoes from a revolving magazine further avoids all dangerous changes of trim as the centers of gravity of the weights displaced are all symmetrically disposed about the axis of the revolving device

In addition to these advantages this system of storing loading and discharging torpedoes in submarines enables the designer to concentrate the offensive power forward, in the most effective position for torpedo-attack and compact form The speedy and simple way in which the device may be operated also contributes to the discharging of the torpedoes more rapidly and more easily than by the difficult and complicated handling which the system now in use requires

War Game—V

(Concluded from page 405)

a rapid advance, which bears all the signs of a determination to press forward at all costs, will be the main factors in achieving success

The coöperation, the team work, of the advancing troops and the fire of the artillery together with the timely advance of the artillery to be on hand in case of need, and for possible pursuit of the retreating Blues, will be all important.

Questions

Question 1 Formulate the order which the commander of the Reds would send to the commander of the cavalry regiment when he has made his decision to attack

Assume that Lieutenant Colonel LC is in command of the Reds

Question 2 Using as a basis the general situation of the Reds as it was before the arrival of the reinforcing cavalry regiment, plan and place on the map the cavalry after the attack which was repulsed by the Blues

Question 3. It is assumed that the Reds succeeded in crossing the creek, and are at a distance of 800 yards from the Blue line of skirmishers. Where will the Red artillery be? Will it remain on Chester Hill, or will it move to another position?

Taking your answer to this Third Question as the situation place all the troops in position on the map.

Question 4. Which point of assault would be the most promising of results for the Reds to select?

Question 5. What would be the result of the capture by the Reds of the crest of Lookout Hill? Consider the situation of the Blues and the mission of the Blue detachment.

Question 6. In case of defeat by the arrival of Blue reinforcements, which way would the Reds retire?

Question 7. Night has fallen. What will happen?

Answers to Questions in War Game—IV

Question 1 The commander of the First Battalion, upon receiving Colonel K's order to take his battalion into action, will call his captains, and after explaining the situation to them will give the order

"We will attack the enemy along the lower portion of Timcum Creek, in the direction of the bridge

"'A' company will attack the enemy's line east of the bridge, 'B' company will attack west of the bridge

"'C' and 'D' companies as reserve will follow 'B' company

"I will be with the reserve'

Compare Colonel K's order with this to see how the battalion commander has worked out the details of that portion of the action allotted to him

The reserves of the two companies going directly onto the firing line are called "supports.' Whether the company will have its own supports or not, and when and how they are to be used is for the company commander to decide When we speak of 'reserve we mean the reserve of the battalion

Question 2 Captain C, as left flank guard has to cover almost a mile before he can get in touch with the cavalry skirmishers holding the lower edge of Pine Forest He will proceed almost directly east marching his company through the woods in 'security formation,' which is very similar to the formation adopted by the detachment in gaining Lookout Hill However, the passage of woods or thickly covered country needs special security measures in order to guard against a possible surprise Patrols may be sent ahead to reconnoiter At times the leading element may be deployed as skirmishers and by pushing ahead cover the front of the advancing column

The chief aim of the flank guard will be to reach the eastern edge of Pine Forest with a patrol and ascertain that no enemy is to be seen in that neighborhood

Question 3. See diagram

Question 4 Lieutenant Colonel LC of the Reds will put one battalion on the firing line By retaining control of two thirds of his infantry as reserve he will be able to assume the offensive if the proper occasion should arrive As soon as the reserves have been sent into the action, the control of the action has slipped from the hand of the leader Therefore the defensive line will not be a single line of closely packed men, but exactly like the line of skirmishers of the attacking party rather thin and strengthened at need by pushing in portions of the reserve

Question 5 The answer to this question may be decided by a comparison Suppose you were in a house with a few friends and this house should be attacked by a band of outlaws what would be your first thought for defense? Naturally to guard the doors and windows By every available means you would attempt to strengthen these weak points This same course must be followed in combat With the help of the reserve which you have held out you close the doors against the enemy

In the present case the doors through which the enemy may come, are the bridge the partially destroyed railroad bridge and the forest on the right The last two approaches are rather distant therefore the bulk of the reserve should be retained directly north of the bridge

Question 6 The artillery should be placed on the slope of Chester Hill behind the house near the railway This would partially cover the battery from direct view, and would also permit an effective fire on the sloping hillside which the enemy has to use for approach

At the same time in case the enemy succeeded in reaching the bridge, which is the key to the situation the battery would be in the most effective position to assist the infantry

* * * * * *

War Game VI will deal with the attack enveloping the enemy's flank The details of the enveloping attack will be worked out on the map

(Concluded from page 408)

former 907 New York Ave Brooklyn N Y, N Y The invention resides more particularly in a structure by which instead of compressing the carbureted air or gas in the crank case the air is first drawn into the crank case and compressed so as to force it out under pressure in a highly heated condition through the carbureter to obtain the proper mixture which is fed to the combustion chamber of the cylinder and ignited or exploded to cause the operation of the engine

VALVE OPERATING MEANS FOR INTERNAL COMBUSTION ENGINES I H March Central Delivery Summerville S C This invention provides means for operating the valves which will dispense with the ordinary extra shaft known as the cam shaft and of cross sprockets and chains for rotating the same It provides valve operating means in which the valves are actuated by cams on the main crank shaft in such manner that the valves are only operated at every other revolution of the crank shaft

AIR STARTER FOR INTERNAL COMBUSTION ENGINES I I Cline San Diego Cal This invention relates to an air starter for internal combustion engines the starter being arranged to compress air within a reservoir while the engine is running and by means of suitable valves to subsequently utilise the stored pressure for the starting of the internal combustion engine

MIXING DEVICE FOR USE WITH EXPLOSIVE ENGINES—H W Allen P O Box R Coalinga Cal This invention provides a device adapted to be arranged between the engine and the carbureter, and having mechanism for thoroughly mixing the several elements of the explosive charge to make a homogeneous mixture and wherein controlling mechanism is provided controlled by the action of the engine for regulating the amount of the charge of fuel admitted

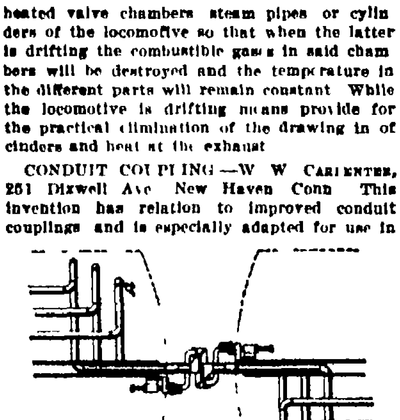
CARBURETER—E H Arquembourg 71 Rue du Moulin Vert Paris France This invention has for its object an improvement in carbureters for explosion motors and particularly to carbureters with automatic intake for the purpose of allowing said carburetors to give a constant carburation at any speeds of the motor whether running light or under a load

Railways and Their Accessories

COMBINED DRIFTING AND RELIEF VALVE FOR LOCOMOTIVES—J F Miller, 743 14th St Douglas Ariz This invention provides a drift valve associated with a relief valve of any preferred construction and automatically operated upon the actuation of said relief valve to admit a constant supply of saturated steam from the boiler to the main superheated valve chambers steam pipes or cylinders of the locomotive so that when the latter is drifting the combustible gases in said chambers will be destroyed and the temperature in the different parts will remain constant While the locomotive is drifting means provide for the practical elimination of the drawing in of cinders and heat at the exhaust

COMBINED DRIFTING AND RELIEF LOCOMOTIVE VALVE

CONDUIT COUPLING—W W Carpenter, 251 Dixwell Ave New Haven Conn This invention has relation to improved conduit couplings and is especially adapted for use in connection with railway rolling stock or other coupled vehicles of transportation for the purpose of carrying fluids gases electric currents, and the like these constituting the source of power or energy for the drawing of the train and for stopping the same by applying the brakes for lighting purposes or what not



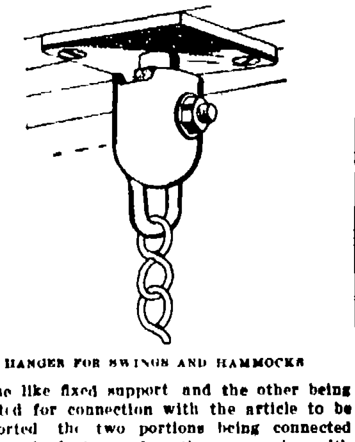
CONDUIT COUPLING

SLEEPING-CAR—E Flagg, 109 Broad St., New York N Y. The invention relates to sleeping-cars of compartment and dormitory type An object thereof is to provide a sleeping-car structure having a larger number of berths in a standard car length than hitherto has been possible thus securing greater efficiency and economy in floor space

Pertaining to Recreation

PLAYING CARDS—J S Warram care of R. E Butrick 30 Church St New York, N Y The invention consists of two packs of cards, there being printed on each card an animal musical instrument or device with words indicating the call of the animal or device The cards in each pack are numbered so that when the cards are dealt the players having cards with corresponding numbers may make the sounds indicated on the cards each player endeavoring to guess the other player who is making the sound indicated by the words on his card.

HANGER FOR SWINGS AND HAMMOCKS—W J Black 41 Ellis St Atlanta Ga The hanger consists of two portions connected in such manner that one of the said portions may be firmly and rigidly secured to a ceiling or the like fixed support and the other being adapted for connection with the article to be supported the two portions being connected so that the last named portion may swing with respect to the first named portion in opposite directions, and in the same plane within limits, and wherein the connection is so arranged that the action will be noiseless during the swinging movement



HANGER FOR SWINGS AND HAMMOCKS

TOY PISTOL—I S Bixler, care of Kenton Hardware Co Kenton Ohio The purpose in this instance is to provide a toy pistol constructed to represent a hammerless magazine pistol the hammer being disposed within the casing and having a stud extending through a slot in the side of the casing by which the hammer may be cocked

RESILIENT PLATFORM FOR STRIKING BAGS—R N Diehl 2300 South Grand Ave, Los Angeles, Cal. This invention relates to a structure on which a striking bag or a punching bag is mounted the structure being generally termed a striking platform and receiving the impact of the bag when struck It relates particularly to a striking platform in which the element presenting a surface or surfaces is resiliently supported to yieldingly receive the impact and by reaction to exert a return force on the bag

ADJUSTABLE GOLF TEE BOARD—M Fuchs Baker Ore An object of this improvement is to provide a golf tee board having tee elements movable to provide separate individual tees either of which may be positioned for use and thus provide a tee at different elevations above the board to meet the ideas of individual players

GAME APPARATUS—P J McCullough, 5201 Delmar St. St Louis, Mo The player directs the device by a limited number of movements over the surface of the board from an optionally designed starting point over a designated route to a particular selected destination, there being appurtenant to the board impediment pins adapted to be variously positioned adjacent to the starting point and between the same and the point of destination to limit the directions and movement that may be imparted to the mobile device in routing its course to the point of destination

GAME—J Kerr Adrian Mich In this case the invention has for its general objects the provision of a toy which is suitable for playing as a game the toy including novel means for holding a piece which is adapted to be thrown into the air and drop into a pot suitably placed.

Pertaining to Vehicles

RESILIENT WHEEL—G W Watts, 82½ Central Ave, Hot Springs, Ark This invention provides a construction of springs for absorbing shocks incident to the travel of a vehicle It provides a wheel having an inner hub member and outer rim member between which are positioned a plurality of flat spring members each engaging, at both ends, the outer rim and, intermediate its ends, the inner hub member

SPRING HUB CONSTRUCTION FOR VEHICLE WHEELS—S D Simmons and H Amling. Address the latter, 4228 Park Ave, Bronx, N Y, N Y This invention has to deal more particularly with a resilient hub construction whereby pneumatic or other resilient tires and their attendant disadvantages are dispensed with. It provides a wheel having spring means embodied in the hub and acting between the wheel and the axle to provide a cushioning action against the wheel and vehicle body

Note.—Copies of any of these patents will be furnished by the Scientific American for ten cents each Please state the name of the patentee, title of the invention, and date of this paper

The Gasoline Situation

It seems unnecessary to go to any unreliable source for information concerning the gasoline situation when we have an organized bureau of the Government which has devoted so much attention to the subject as the Bureau of Mines. As a matter of fact, if Director Manning had not about one year ago dug Dr Rittman out of the laboratory in New York and put him at work on investigations of the importance of gasoline we probably would be just a year behind the point where we stand with regard to the development of the gasoline production

The General Supply Schedule Committee organized by the Government has received bids for the supply of gasoline to the Government for the four months beginning July 1st 1916 The lowest bid for the four months is 27¼ cents per gallon, while the lowest bid for the supply of gasoline for the Government for the year beginning July 1st 1916, is 31½ cents per gallon, and this it should be understood is in lots of hundreds of thousands of gallons, so that it is easy to see where the ordinary consumer will be when this wholesale rate to the Government is so high Now, is this the result of manipulation, or is it the result of a normal use of what a few years ago would be regarded as an abnormal consumption of gasoline?

Senate Document 310 is rich in information as to the source of gasoline and its use, and the reason for the enormous use which has led to present conditions. Dr Rittman in public utterances tells us at this time there are in the United States 2,250,000 automobiles, while the country is manufacturing between 3 000 and 4,000 additional atuomobiles each day, one company making at the rate of 2 000 a day while another is making 500 a day so that the automobile companies at the present time are producing considerably more than 1,000 000 per annum In addition to this there are 300,000 motor boats in the United States and 700,000 internal combustion engines in use on farms and elsewhere At 500 gallons of gasoline per year per automobile, this reaches the sum total of 1,200,000 000 gallons of gasoline more than 29,000 000 barrels The new automobiles being put into commission each day together with other engines on motor boats and farms mean an accumulated daily increase of considerably more than 7,500 gallons of gasoline per day

Now as to exporting While little more than a year ago we were exporting about 100,000 000 gallons of gasoline per year, we are at the present time exporting between 300 000 000 and 400,000,000 gallons per year, the exports thus equalling 30 to 40 per cent of the entire American production As to the output, the Cushing, Oklahoma, field a year ago was producing daily more than 300 000 barrels of crude oil, while at the present time the yield is at the rate of less than 100,000 barrels a day, showing a loss at the rate of 73 000,000 barrels a year As a matter of fact the United States production of crude oil, whose content of gasoline is high has fallen off and there is less likelihood of discovering new fields such as the Cushing field It must not also be over looked that much of the new oil discovered in America does not naturally contain gasoline

In the foregoing some reasons are set out why the price of gasoline has advanced as a natural commercial result of both increased demand and decreased production It remains to be seen in what way the Government can control a situation which appears to be affected by purely natural conditions of supply and demand

In the Senate Document 310 the situation is summed up generally by pointing out that the consumption of gasoline is rapidly increasing, and that the production of crude oil has been generally regarded as nearest its maximum It also indicates that some immediate relief may be secured by the use in internal combustion engines of heavier distillates approaching kerosene, that an acceptable kerosene carbureter would at once go a long way toward relieving the present shortage of gasoline, and such relief as might result from a general use of cracking processes whereby gasoline is made from kerosene and other less valuable petroleum oils, which cracking processes are being rapidly developed and do promise some relief in the near future

With a view to relieving the situation as far as possible at the present time 11 refining companies have just been licensed under the Rittman process, and it remains to be seen just how far this will affect conditions

When the great demand and the shortage in supply is considered, the necessity of conserving the present resources is emphasized, and in a future article we shall deal with conservation of such resources, especially from the point of view of the Government experts who are giving the matter consideration.

Is the Chinese Dragon Based on Fact, Not Mythology?

(Concluded from page 399)

altogether fails to impress the foreigner After proceeding some hundred yards inside the cave we found ourselves walking on a peculiar ridge in order to avoid the surrounding pools of water This ridge curved backward and forward across the width of the cave like the curves of a large serpent, the suggestion being so strong that we lowered our lamps in order to examine the ridge more closely To our astonishment and delight, we found that we were in very truth walking along a perfect fossil of some huge reptile. Further inspection revealed the presence of six or eight of these enormous monsters Having taken a few small specimens of loose portions of scale for examination in a better light, we left, planning to return the following morning for the purpose of measurement

On our return the following morning we selected one of the largest fossils lying for a great part of its length isolated from the others—the coils of the remainder being rather entangled. The isolated portion measured 70 feet, so that it is absolutely certain that the length is at least 70 feet and as far as we could ascertain, this same specimen extended for another 60 or 70 feet. However, I admit that error is possible here, owing to the interlacing coils of the reptiles. The depth of the body seen in the foreground of the first illustration is two feet. The head is partially buried in the cave wall and appears to be a large, flat head similar to that of the *Morosaurus Comperi*. About 12 or 14 feet from the head two legs are seen partially uncovered, and again two more about 50 feet from the head The fact that several persons have penetrated this cave in former years beyond the point where the discovery was made seems to indicate the fossils have been but recently uncovered, probably by a heavy discharge of water through the cave. It seems probable that these reptiles were trapped by some volcanic disturbance and starved to death, the size of the bodies compared to their length would indicate this A point of peculiar interest is the resemblance to the Chinese dragon of these fossils. I believe that it has heretofore been supposed that the Chinese borrowed their idea of the dragon from Western mythology The discovery has created a great stir among the local Chinese and foreigners, who are daily flocking to view the fossils. I am attempting to interest the Chinese authorities in Pekin and also the Chinese Monuments Society in order that the specimens may be preserved from damage

How the French Soldiers Wage War on Trench Rats

(Concluded from page 390)

suffocated by the acetylene gas disengaged.

Since 1906 the "deratisation" of ships has been compulsory at all the ports of France. This is usually accomplished by sulfurous anhydride, which also kills all other vermin. The simplest way of producing this gas is by the combustion of

sulfur. Sometimes the liquified anhydride is sprayed by suitable apparatus.

The microbic destruction of rodents, previously referred to, has been developed by the Pasteur Institute. Dr Danysz, "Chief of Service" at that famous institution, has prepared a culture of a bacillus somewhat similar to the *bacillus paratyphic B* and the bacillus of enteritis, known as the *typhic bacillus of rats, type D* It is pathogenic to all species of rodents. Mice and field mice succumb to it in two to eight days, the gray rat, which is more resistant, in five to fifteen days. Sometimes a few individuals seem to have escaped the malady, but perish of feebleness at the end of two or three months. An inoculated individual has never been known to be cured. This virus, so fatal to rodents, is harmless when injected in men or other animals It has been observed, however, that food polluted by dejecta from sick rodents may cause accidents to men. For this reason it is not regarded as safe to employ this method in the trenches, where life is peculiarly favorable to such pollution and where numbers of the men are in a debilitated condition which invites fevers of the typhoid type

The Danysz virus is prepared in cultures of meat broth. It conserves its virulence a couple of weeks It is used to impregnate grain or other food In exterminating field mice 8 kilograms of grain thus treated is required per acre. The malady is transmitted by the absorption of the grain and also by contagion, since the animals devour the dead and moribund members of the species. Experiments have proved that from 95 to 98 per cent of the mice are thus destroyed

For ridding the trenches of the fierce gray rats which add so much to their discomforts and dangers, the Pasteur Institute advises the use of extract of squills. But it is necessary to have a plan of campaign, since the rat is crafty and wary and quickly takes alarm This plan consists in attracting the rats to special feeding places by an abundance of wholesome provision They come in increasing numbers, until at the end of several days practically all are accustomed to come to certain spots at certain hours. Thereupon the poisoned food is set forth, and all are killed The work is considered of such vital importance that it has been undertaken by the military *Service de Santé* Squads of four men are formed and equipped Each squad is capable of treating 5 000 meters of trenches, or 5,000 square meters of barracks, per day, using 10 bottles of extract to prepare 60 kilograms of bait made with milk or bread Strict orders are enforced, likewise, as to the collection and incineration of organic debris Finally, some of the officers have stimulated the interest of the men in the work of destruction by offering a premium of a *sou* per head for dead rats, which has induced the men to enliven the trenches by a new sport.

Industrial Preparedness for Peace

(Concluded from page 400)

grow and prosper A few weeks before these men had been opposed to the "time study" method of observing an operation. A short time before these men had questioned him and agreed with him regarding the necessity of scientific research in industrial operations. He went home that night satisfied because every last one of them had, without his suggestion, analyzed the operation, drawn his watch from his pocket, and measured the operation by timing its units The change in attitude was felt throughout the plant. Men began to study their jobs. They were getting a new viewpoint. They cultivated new habits, and the new habits gave them still newer viewpoints. He found one man "timing" himself with an alarm clock and he kept an accurate record of his work for an entire day At a meeting of our "Club," as we began to call it, he proved to us that 86 per cent of his time was wasted through avoidable delay He made a bitter attack upon the repair department, and condemned the purchasing department for the poor belting on his machine The seeds of efficiency were sprouting

The Conversion of John Holt

John Holt had attended each and every one of these meetings. He had sat apart and watched the proceedings with a languid interest. From day to day a change was noticed He began to accept changes, and each change led to other changes. John Holt was open to change when that change was brought about through his own mind and heart. We were able to introduce the principles of efficiency, and achieve the anticipated results without discharging a single man, without having a single serious discussion. We were able to do these things He meant by the "We" John Holt, the workers and the "efficiency engineer"

Industrial Education

He had made a discovery He had found that scientific management required an educative method That education as a method of developing coöperation was more effective than executive authority and the theory of force In our campaign for Industrial Preparedness for Peace we are seeking a high productive efficiency We can achieve this goal if we still take adequate recognition of this educative factor in industry The owners and managers of large industrial plants can learn much from this story of John Holt Scientific management must start with education Not a class-room exercise, but a laboratory school wherein management and men will have an opportunity to study the problems of efficiency together If the efficient way is the better way then the worker should be taught the ways of efficiency Fast horses are developed through breeding training and careful attention against over strain The forced horse is not efficient—he is soon a wreck Unlike horses, men may be educated led, and guided by intelligent coöperation All men have potential capacity for efficiency

The Efficiency Viewpoint

Industrial Preparedness for Peace will depend upon our viewpoint of the meaning of efficiency If it means merely a system of cards and files, a forcing, driving method of doing things we shall make little headway If we shall look upon *efficiency* as the conservation of our resources, the saving of our energies, the direction of our efforts, the establishment of coöperation—we shall then become adequately prepared for the economic and industrial struggles to follow the war He read an advertisement the other day which had as a heading

"The dumbest oyster can make a better pearl than the wisest man"

This truth applies to the problem of efficiency The pearl of real human efficiency is a growth of nature We efficiency men may create an imitation but that efficiency which is the outgrowth of an educative and coöperative system will stand the tests of purity

From the Editor's Mail Bag

The Cleveland Chamber of Commerce,
Cleveland O

"I have noticed with interest the series of articles which you have recently contributed to the SCIENTIFIC AMERICAN on 'Industrial Preparedness for Peace' I do not know whether you have completed your series or not, but I take the liberty of calling your attention to the work that this Chamber is carrying on along these lines. The plan of the Cleveland Industrial Development Company somewhat follows that of the recently incorporated American International Corporation of New York, having, of course, a naturally more limited field

"As one of the methods of meeting the situation, however, I thought it might interest you.

"Following closely upon the announcement of the incorporation of the American International Corporation of New York, and the Allied Machine Company of America, in assisting American interests in securing business relations from foreign companies, the Cleveland Chamber of Commerce has just announced a

plan for improving the industrial preparedness of this city.

"Its directors have just approved a plan for an industrial development company to be known as the Cleveland Industrial Development Company, with a capitalization of $500,000 of common stock, and $100,000 in preferred stock. This is divided into shares of $100 each, and the company will undertake the financing of such industrial organizations as may be deemed worthy of support and which desire to locate in Cleveland The plan proposes a promoting company with sufficient paid up stock to permit of operation, to investigate and report upon industrial development for the benefit of its stockholders. The company will be independent of the Cleveland Chamber of Commerce, but will work in harmony with the Chamber at all times.

"The first board of directors will contain among others the members named by the board of directors as the committee on organization who have also been requested to act with others as the first board of directors of the new corporation The fundamental idea underlying the proposed plan is similar to Lloyds Association of London which as is well known, is an association of merchants, ship owners, underwriters and insurance brokers grouped together for underwriting purposes The Cleveland Industrial Development Company will operate largely in this same manner, as it is a promoting company organized for the purpose of securing and disseminating in concrete form detailed information concerning the industries to be promoted These facts are to be placed before the members who become the underwriters of the promoted companies

"To insure the success of this organization, the industrial development committee of the Chamber which has had the matter in charge, has insisted that there must be at its head a group of men of broad experience possessing the business acumen necessary to enable them to grasp to the fullest extent the opportunities that are offered and to realize the advantages accruing to industrial enterprise through changing local and world conditions.

"The Cleveland Chamber of Commerce is confident that the plan is a feasible one and that the company, when organized will be admirably adapted for the work it is to do

"In order to further carry out its plan of industrial preparedness, the Chamber Committee on Industrial Development is giving in the auditorium of the Chamber, at each Tuesday's noon-day gathering an exhibition of the work of some industrial activity in the city

"Cleveland is making rapid growth in the manufacture of automobile parts and accessories, and the Committee on Industrial Development is, at present, in communication with a number of firms relative to the erection of factories for the manufacture of automobile bodies and parts A recent exhibition at the automobile show was a demonstration of a newly acquired industry for the manufacture of Standard Automobile Tires, and the success already attained by this company is regarded as an indication of the wonderful possibilities that Cleveland presents for industries of this character

"Further than this, the Foreign Trade Department of the Cleveland Chamber of Commerce is aiding manufacturers in every possible way in extending their trade abroad

"Specifically, the department is furnishing information in regard to foreign markets for different lines of goods, names of manufacturers, agents and dealers, trade extension methods to be used, etc.

"It maintains a coöperative branch office of the U S Bureau of Foreign and Domestic Commerce, and is therefore utilizing the Government's facilities for promoting American trade abroad.

"It is bringing to Cleveland business men from foreign countries who are purchasing goods, or who are making contracts to represent manufacturers. American consuls are brought to Cleveland whenever possible in order that manufac-

turers may confer with them as to opportunities in the consuls' districts for the sale of certain lines of goods, and to get their advice as to the proper methods to use.

"The department is making investigations for manufacturers pertaining to foreign markets for their products and no effort is spared to promote their foreign trade interest in every way."

Increasing the Profits in Flax Mills

(*Concluded from page 402*)

after decomposition sets in. The water is usually turned on at dusk as it takes all night for the tanks to fill.

In ordinary July and August weather four or five days is usually sufficient to effect the dissolution of the adhering gums so that the fiber can be extracted. Extreme care and diligence are needed to determine the exact stage at which the operation is completed. That is why Fraleigh has cautiously stopped half way—at mixed retting. The 45-cent fiber however was obtained from straw that had practically completed retting in the tank.

At a point about halfway toward the completion of the retting operation the water is drained off and the flax removed. It is carefully transported to an adjoining meadow and spread evenly in rows as for dew retting. The time required on the grass varies according to the condition of the flax and the state of the weather.

Not only does the water process enhance the value of the fiber but as a substitute for dew retting it often means the actual saving of great quantities of flax. Let us see how dew retting involves such losses.

In the first place because of the shortness of the season following threshing time great areas of straw are frequently spread before any is ready to lift. A prolonged wet spell occurring at such a point causes over retting of a portion of this straw. In a word the operator is at the mercy of the weather.

The tentative operations at water retting at the Forest plant have been so encouraging that several more tanks are to be constructed this spring. At present there is no covering for the tanks. It is proposed to remedy this deficiency by the erection of a roofed structure with extended sides. This will enable men to work in all sorts of summer weather. All the work connected with handling the straw has so far been accomplished by hand. Consequently there remains to be worked out once the success of the process warrants it some system of power driven traveling cranes and carriers to effect the cheap transfer of the straw from wagon to tank and vice versa. This is a minor point quite outside the retting process proper however.

Removing the Fiber

The third step in flax working is that of removing the fiber from the encumbering woody chive. In actual practice this operation has the most bearing on the final returns. For example one Ontario mill bears a scutching bill at the rate of about two cents per pound of fiber. Another pays for inferior work at the rate of about five cents per pound. It is practically all in the quality of the labor. At the best mill in Canada the scutching force has been trained for efficiency over a period of years. Once initiated into this mill whose atmosphere is cleaned by a suction fan and heated by steam pipes a scutcher never migrates to another flax mill. There is an *esprit de corps* that is quite unprecedented in my records of American flax mills. From the proprietor down to the boy sheaf handlers the attitude is one of enthusiastic striving for more knowledge and greater efficiency. The very fault of the poorest mills is that know-all *laissez-faire* bearing which is incompatible with true progress.

Good scutching not only produces a clean, high quality of fiber, but a high percentage of such fiber. In the progressive flax mill the percentage of tow is usually about 10. In the misgoverned plant it may run as high as 30 per cent. How important these figures are may be judged by the comparative prices paid

for ordinary fiber and tow products of an Ontario mill.

Dressed fiber	20 cents per lb.
Fine tow	11 " " "
Coarse tow	1¾ " " "

The insignificance of the prices paid for tow demonstrates the importance of keeping the untangled fiber out of such bad company, and of distributing flaxes of various qualities in respective grades This can be most effectively done, as already stated, when pains are taken from the time of harvesting I have mentioned the assorting of flax in the field. These lots are kept separated throughout later operations Furthermore, whatever differences in quality may be created during dew retting are the basis of further sorting For example, one field may have the advantage of favorable weather Another may have been retted too little or too much Different kinds of fiber will necessarily result from such fields. To mix the two kinds of straw would reduce the value of both to that of the less valuable

Such preliminary examples of grading are consummated when the scutching and baling are done Unequal scutching produces uneven flax, and dew retting is unavoidably the cause of uneven fiber This disadvantage can not be wholly overcome by the skill of the grader To accomplish such a result every fiber would have to be examined, and that is obviously impracticable Therein lies the essential weakness of the process of dew retting

The skillful grader at the Forest mill makes half a dozen lots, which are baled separately for shipment. The prices received vary according to quality Grading increases the returns between 15 and 20 per cent.

NEW BOOKS, ETC.

WHITAKER'S PEERAGE BARONETAGE KNIGHTAGE AND COMPANIONAGE 1916. New York J Whitaker & Sons, Ltd., 1916. 8vo , 905 pp Price, $2

It is unlikely that any one needing to refer to some such work as Whitaker's ' Peerage would be ignorant of its existence and its scope so that a long description is hardly called for The contents comprise an obituary, which includes a roll of honor of those killed in action or dead from wounds an indexed introduction describing the regalia and giving the details of accession etc and concise information concerning the peerage and its degrees This is followed by the Royal Family by an alphabetical directory of the peerage in which precedence is ignored for the sake of easy reference and by an index to seats and residences of persons cited in the work.

THE AMERICAN WHITAKER ALMANAC AND ENCYCLOPEDIA. 1916. New York J Whitaker & Sons Ltd 8vo., 552 pp , illustrated. Price, $1.00

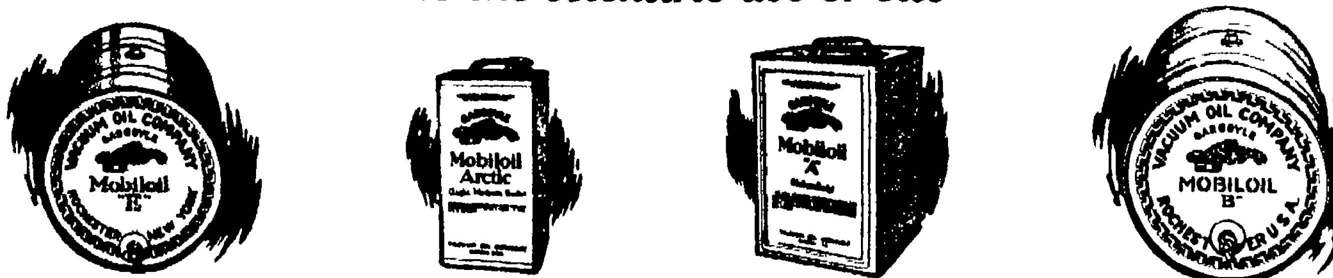
The Whitaker Almanac for 1916 presents an array of facts, some 9,000 in all covering agriculture, finance, industry, sport, and all the more important activities of the world with particular reference to America Each State has its own section carrying an outline map, and citing physical features government, defense education finance, and production and industry The main events of the year 1915 are chronicled, and a considerable division of the work is devoted to the great war including the relations of the United States with the belligerent powers.

WAYS TO LASTING PEACE. By David Starr Jordan Indianapolis The Bobbs-Merrill Company, 1916. 8vo , 265 pp. Price, $1 net.

In all the leading nations a great deal of constructive thought—more, no doubt, than is generally realized—has been occupied since the outbreak of the war with devising means for settling international disputes without resort to arms. Dr Jordan recognizes three kinds of peace millennial contentment, the armed peace which he designates 'balanced hatred, and the permanent peace of law His book summarizes, analyzes and compares the various plans put forward by organizations and individuals with a view to permanent peace The author has done humanity a service in collating the most promising of these proposals in a single volume, thus bringing their strong and weak points into sharp contrast. If he discloses any mistake in judgment, it is in his over-emphasis of the adequate organization for defense as a danger tending toward the precipitation of war. Defenselessness and militarism are the two extremes to be avoided; adequate preparedness is the happy medium. His arguments are, however, generally well-balanced, and cannot fail to bring the practical man and the idealist closer to a mutual understanding.

Science vs. Guesswork

How "hit-or-miss" lubrication gave way to the scientific use of oils



Fifteen-gallon drum — One gallon can — Five gallon can — Thirty gallon drum

All grades come in above packages and in addition in fifty five gallon steel drums and wooden half barrels and barrels

Friction in any power plant—whether steel mill or automobile motor—is the worst enemy of economy and full power.

The practical need for something to reduce friction brought about the first use of lubricants.

It was found that petroleum oil would yield a lubricating oil which had many marked advantages, and would produce different types of lubricating oil.

Development in the manufacture of different grades and classes of lubricating oils came at a fortunate time. For mechanical arts developed rapidly.

Unless the lubricating problems were properly met, mechanical development would fail in its aim. Only the properly lubricated engine or motor could yield the efficiency aimed at.

The Vacuum Oil Company were the first manufacturers of petroleum residual lubricants, and were the pioneers in the field of scientific lubrication and demonstration of power saving by the use of proper lubricants.

In taking up automobile lubrication, the Vacuum Oil Company simply pursued its professional methods which were already well established in other fields of power-production and transmission.

The Chart of Automobile Recommendations on the right represents our professional advice.

In using the oil specified for your car, you will use oil whose correctness was determined by very thorough and careful engineering analysis of your motor. The oil specified combines *high quality* with *correct body*.

It makes for

(1) *Increased power — noticeable particularly on the hills.*

(2) *Reduced carbon deposit.*

(3) *Reduced gasoline consumption.*

(4) *Reduced oil consumption.*

(5) *Freedom from unnecessary repairs.*

If you use an oil which less correctly meets your motor conditions from a scientific standpoint, you are almost surely pouring trouble into your crank case.

If your car is not listed in the Chart at the right, a copy of our complete Lubricating Chart will be sent you on request.

GARGOYLE

Mobiloils

A grade for each type of motor

In buying Gargoyle Mobiloils from your dealer, it is safest to purchase in original packages. Look for the red Gargoyle on the container. For information, kindly address any inquiry to our nearest office.

VACUUM OIL COMPANY - Rochester, N. Y., U. S. A.

Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world

Detroit New York Philadelphia Minneapolis Boston Chicago Indianapolis Pittsburgh Kansas City Kan.

Correct Automobile Lubrication

Explanation:—The four grades of Gargoyle Mobiloils for gasoline motor lubrication, purified to remove free carbon, are

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

In the Chart below the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example "A" means Gargoyle Mobiloil "A", "Arc" means Gargoyle Mobiloil "Arctic", etc. The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

MODEL OF	1916		1915		1914		1913		1912	
CARS	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
(8 cyl)	A	A	A	A						
Apperson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(8 cyl)	A	A								
Auburn (4 cyl)	A	Arc	A	Arc	A	A	A	A	A	A
(6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc				
Autocar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Avery	A	A	A	A	A	A	A	A	A	A
(Mod 5&C 1 Ton)	Arc	Arc	A	Arc	Arc	Arc				
Briscoe	A	A	A	Arc	A	Arc				
(8 cyl)	A	A								
Buick	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Cadillac					Arc	Arc	Arc	Arc	Arc	Arc
(8 cyl)	A	A	Arc	Arc						
Cartercar			Arc	Arc	Arc	Arc	A	E	A	E
Com'l							A	Arc	A	Arc
Case	A	A	A	Arc	A	A	A	Arc	A	Arc
Chalmers	Arc	A	Arc	Arc	A	A	Arc	Arc	Arc	Arc
(Model 6-40)	A	Arc								
(Model 6-30)	A	A								
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc				
Chase (air)	B	B	B	B	B	B	B	B	B	B
(water)	Arc	Arc	A	Arc	A	Arc				
Chevrolet	Arc	Arc	Arc	Arc	A	Arc	A	A		
Cole	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(8 cyl)	A	A	A	A						
Cunningham			Arc	Arc	Arc	Arc	A	A	A	A
Delaunay Belleville			B	A	B	A	B	A	B	A
Detroiter	Arc	Arc	A	A	A	A	A	Arc	A	Arc
(8 cyl)			Arc	Arc						
Dodge	A	Arc	E	E						
Empire			Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Federal	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc
Fiat	B	A	B	A	B	A	B	A	A	A
Ford	E	F	E	F	E	E	E	F	E	E
Franklin	A	A	A	A	A	A	A	Arc	A	Arc
Grant	A	Arc	Arc	Arc	Arc	Arc				
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(12 cyl)	A	A								
Hudson	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
Super Six	A	A								
Hupmobile	A	Arc	A	A	A	Arc	A	Arc	Arc	Arc
I H C (air)			B	A	B	A	B	A		
(water 2 cycle)	A	A	A	A	A	A	A	A		
" (water 4 cycle)	A	Arc								
International			A	Arc	A	Arc	A	Arc	A	Arc
Jackson	Arc	Arc	Arc	A	A	A	A	Arc	A	Arc
(8 cyl)	A	A								
Jeffery	A	Arc	A	Arc	A	A				
(Chesterfield)	A	A	A	Arc						
Com'l	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kelly Springfield	A	A	A	A	A	A	Arc	Arc	Arc	Arc
King			A	Arc	A	A	A	E	A	E
(8 cyl)	A	A	Arc	Arc						
Com'l	Arc	Arc	Arc	Arc	Arc	Arc				
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Com'l	A	Arc	A	Arc	A	Arc	Arc	A	Arc	Arc
(Model 48)	A	A	A	A	A	A				
Kline Kar	Arc	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Knox	B	A	B	A	B	A	B	A	B	A
(Model 35)	A	A	A	A						
Locomobile	E	E	E	E	E	E	Arc	Arc	Arc	Arc
Lozier	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Marion	A	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
Marmon	A	A	A	Arc	A	Arc	A	Arc	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer			A	Arc	A	Arc	A	Arc	A	Arc
(22-70)			Arc	Arc						
(22-72)	A	A								
Metz	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(8 cyl)	A	A								
Moline							A	Arc	A	Arc
Knight	A	A	A	A	A	A				
Moon (4 cyl)			Arc	Arc	A	Arc	Arc	Arc	Arc	Arc
(6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc				
National	A	Arc	A	Arc	A	A	A	A	A	A
(12 cyl)	A	A								
Oakland	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
(8 cyl)	A	A								
Oldsmobile	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
(8 cyl)	A	A								
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard			A	Arc	A	Arc	Arc	Arc	Arc	Arc
(12 cyl)	A	A								
Com'l	A	A	A	A						
Paige			A	Arc	A	A	A	E	A	E
(6-46)	Arc	Arc	Arc	Arc						
(6-36 & 38)	A	Arc	A	Arc						
Pathfinder	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc		
(12 cyl)	A	A								
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(8 cyl)	A	A								
Pierce Arrow	A	A	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Pullman	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(8 cyl)	A	A	Arc	Arc						
Renault	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Richmond	Arc	Arc	A	Arc	A	Arc	Arc	Arc		
S G V			A	Arc	A	Arc	B	Arc	B	Arc
Saxon	E	E	E	E	E	E				
Scripps Booth (air)					B	A				
(water)	A	Arc	E	E						
(8-cyl)	A	A								
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Simplex	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Stearns Knight	B	A	B	A	B	A	A	A	A	A
(8 cyl)	B	A								
Stevens Duryea			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Studebaker	A	Arc	Arc	Arc	A	Arc	A	Arc	Arc	Arc
Stutz	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Velie (4 cyl)			A	Arc	A	Arc	A	Arc	A	Arc
(6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc				
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Willys Knight	B	A	B	A	A	A				
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

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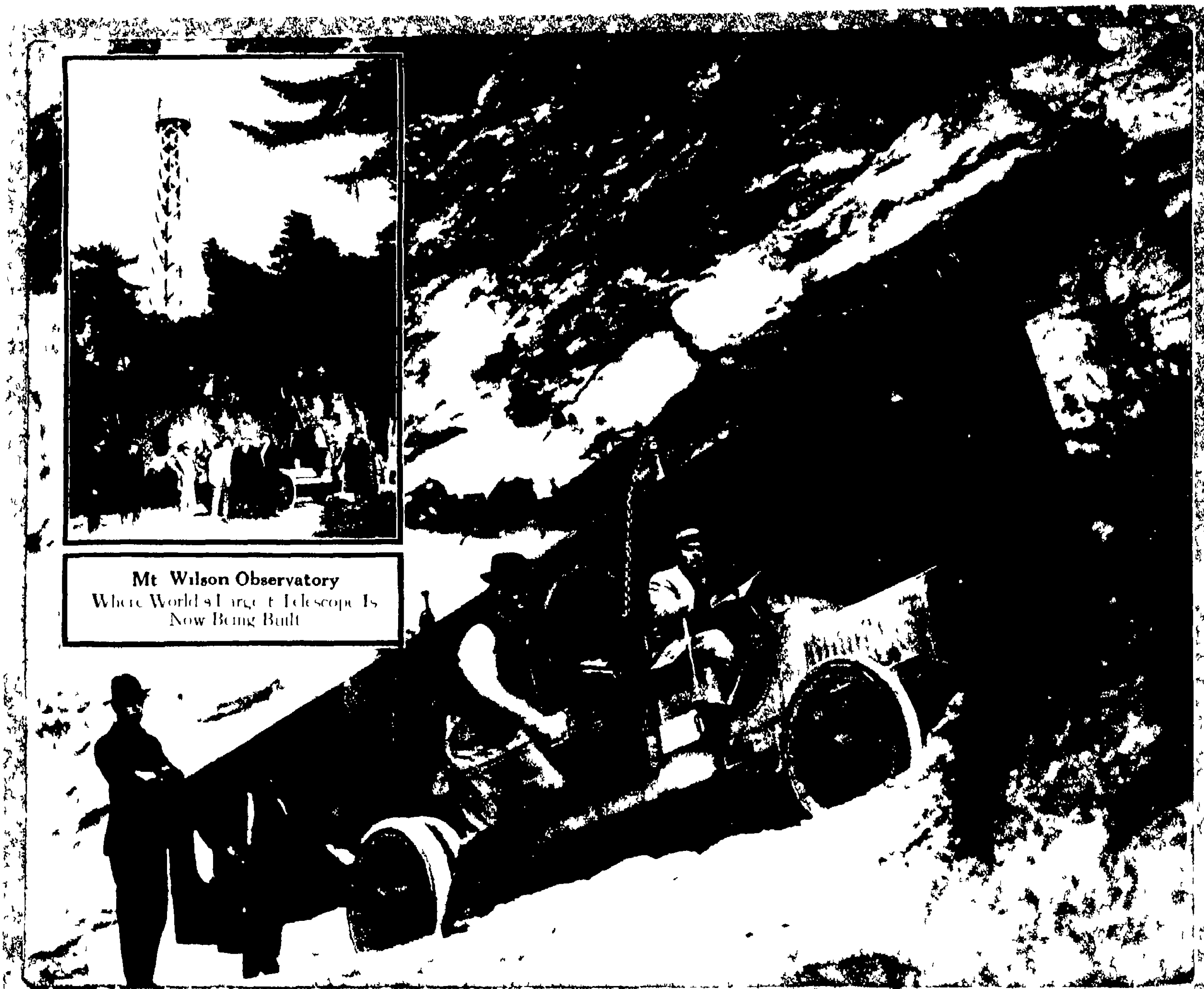

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SCIENTIFIC AMERICAN

GERMAN DESTRUCTION OF LANDMARKS ALONG THE BELGIAN COAST

April 22, 1916

Munn & Co., Inc., Publishers

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SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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Rock dust sprayer at work in the test mine of the Federal Bureau of Mines at Experiment, Pa. The essential parts of the sprayer are a gasoline engine, a blower, a hopper for the rock dust, and a mixing chamber

Preventing Coal Mine Explosions with a Spray of Rock Dust

THE Federal Bureau of Mines has made a large number of explosion trials at the test mine at Experiment, Pa, to determine the efficiency of rock dust in preventing the initiation of mine explosions and in checking them after they have been initiated The proportion of shale dust to coal dust required in preventing or checking explosions has been determined for coal dust from many seams

The rock-dust method appears to have such an advantage over water methods—in which water is applied infrequently—in that more constant protection is afforded, that arrangements were made with a coal company in the Pittsburgh district to rock-dust a part of one of its mines and keep accurate account of the costs. Bureau engineers inspected the rock-dusted zones from time to time and took samples to insure that the zones were in safe condition. This work was continued for a year, the entries being redusted from time to time as the occasion required.

The test just mentioned has been so satisfactory that the dusting has been extended to three other mines, and conferences have been held with officials of other companies for the purpose of explaining results, with the view to adopting the method. Considerable interest has also been shown in other parts of the country, particularly in Colorado, where rock dusting has been carried on in the Delagua mine of the Victor-American Fuel Company for more than four years. The probable wide adoption of this method of rendering coal dust inert, therefore, makes desirable the development of suitable machinery both for preparing the dust and for distributing it.

The first rock-dust used in the Pittsburgh district was pulverized limestone of such fineness that about 75 per cent would pass through a 100 mesh sieve This material was very satisfactory but a coarser material would be easier and cheaper to prepare accordingly explosion tests were made in the experimental mine to determine the relative efficiency of fine and coarse material It was found that material prepared by grinding in a hammer crusher, equipped with a 1/16-inch slotted screen was only a trifle less efficient than the pulverized dust It is believed that suitable equipment to furnish such dust can be obtained at a low cost

In rock-dusting a mine entry the best procedure is to apply the first coating by hand, because a thicker and better distributed coat is obtained. In time coal dust settles on the rock dust, and redusting is desirable. This is best done by a rock dusting machine which blows into the air current a cloud of rock dust that settles in a mantle over the coal dust The use of a machine decreases the cost and increases greatly the convenience of redusting Such a machine as used at the experimental mine and similar to one in use at Delagua, is shown in operation in the accompanying illustration

The mine dusting apparatus is of simple construction In its essentials it comprises a small positive blower a mixing chamber or injector chamber, a rock dust hopper, and a suitable outlet. The air from the blower passes through a two inch pipe to the injector chamber, into which the rock dust is fed from a hopper, and the mixture of air and dust which is thus formed is blown through a hose into the atmosphere The blower used in the experimental outfit of the Bureau of Mines has a volume of 288 cubic inches and is operated at about 1,000 revolutions per minute, the pressure in the outlet pipe when the machine is in use is about two pounds per square inch The injector chamber is carefully although simply constructed Its two inch air inlet is reduced to a nozzle of one-inch opening and the nozzle is extended far enough into the chamber of the three inch tee (which is used for the injector chamber) so that the nozzle opening is below the outer edge of the dust hopper opening The dust then falls or is drawn forward into the air stream and blown through the hose A flexible hose is desirable for an outlet so that the air stream can be pointed in any direction also this permits its connection to pipes through stoppings to direct the dust stream into air courses or entries having no track which ordinarily receive no treatment to render the coal dust present inert. The power to drive the rock-dusting machine is furnished by a small gasoline engine in the experimental mine apparatus

Arsenic in the Hair

NEW light has been thrown on the legal side of arsenic poisoning It has been found that arsenic compounds are absorbed by the hair of living persons though not absorbed after death In the hair of man arsenic has been known to reach a concentration of one to five parts in a hundred thousand The deposit takes place in the hair after it has been absorbed by the abdominal organs—liver and kidney in particular

Therefore in cases of acute, quick poisoning a chemical analysis of the hair would show no arsenic while it would be found in the liver and kidneys On the other hand if slow arsenic poisoning was suspected, analysis would show arsenic in the hair but not in the liver and kidneys, and it could safely be assumed that the poisoning was not recent. The legal value of such evidence is apparent

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Patriotism or Politics—Which?

THE most highly technical department of the Government is undoubtedly that of the Navy. The head of the Navy must by law be a civilian, and because the selection of our heads of departments is determined mainly by political considerations the likelihood of the Secretary of the Navy's possessing any technical qualifications for his task is very remote.

To make good this deficiency the Secretary is surrounded by highly trained technical advisers—officers of the Navy of long experience and proved ability. To them he looks for exact information as to the condition of the Navy. The General Board, the War College, the Chiefs of Bureaus and above all the Aid for Operations are the sources which stand ready to impart the greatly needed knowledge of facts and principles which shall guide the Secretary in his momentous decisions.

Nearest to him as technical adviser is the Aid for Operations. In the autumn of 1914 this office was filled by one of the most able and enthusiastic officers of our Navy, Rear Admiral Fiske, the original inventor of that telescopic sight for guns which forms the basis of the wonderful accuracy of modern naval artillery. Having in view the threat of the European war Admiral Fiske impressed upon the Secretary the fact that our Navy was totally unprepared to go to war with any first class power. Backed up by the report of the General Board he informed the Secretary that we had neither the number of ships, the personnel, the organization, the war plans nor the experience in war maneuvers to qualify us to engage a first class power with any confident expectation of success. The Secretary was informed that it would take five years to secure the needed ships, to enlist and train the needed men, to obtain and make efficient the necessary officers, to develop a General Staff to carry out the necessary reforms in organization, and by means of war maneuvers carried out under war conditions, to bring our fleet up to the high standard of wartime efficiency which marked the best of the world's navies.

And what use did Mr. Daniels make of these startling and most disconcerting facts? He was busy at the time with his annual report to President Wilson. The President depends for his information regarding the Navy upon his Secretary. Did the Secretary make known to the President, and through him to the country at large, the alarming condition of unpreparedness of our Navy? Did he inform the President that we were short ten or a dozen dreadnoughts—that the ships we had were undermanned—that we were short 30,000 men and 2,000 officers—that we had no General Staff—that our fleet, all too small in numbers, was inexperienced in war maneuvers on a sufficiently comprehensive scale—that we had no general and detailed war plans? Did he tell the President that he was informed by his Aid for Operations, his immediate technical adviser, that it would take five years to remedy these defects and bring our Navy up to a condition of full war efficiency?

He did nothing of the kind. A few days after he had learned of our total unpreparedness for war, and with the threatening glare of the European conflagration lighting up our Eastern horizon, the Secretary did not hesitate to write a flamboyant, highly optimistic report on the Navy, in which he most studiously concealed the facts revealed to him by his aid, ending his panegyric as follows: "Allow me, Mr. President, to congratulate you, as its Commander-in-Chief, upon the record it (the Navy) has made *upon its preparedness for duty, upon the reliance you can place upon it in any time of national need*."

The italics are ours. It will be decidedly interesting to compare this statement with the report of the General Board and Admiral Fiske's letter, both of which Mr. Daniels has been directed by the Senate to produce.

An Estimate of German Losses

TO those who believe that the ultimate victory of the Allies will be due to the exhaustion of the Central Powers' supply of men, the estimate of German losses made by the well-known military critic, Hilaire Belloc, in *Land and Water*, will have profound significance. Belloc recently visited Paris for the purpose of obtaining data of an official character, gathered by the Intelligence Bureau of the French War Department, and it is largely upon the material thus secured that the following analysis is based.

The point of departure of Belloc's study is the official lists published by the German Government from the outbreak of the war to the 31st of January, 1916. The number of official lists thus published is 860, and the total number of German dead on these lists is 651,768. This total, it is claimed, is not complete, for over and above the number admitted as dead, the official lists give a certain number as missing. The missing can conceivably cover only three categories: First, prisoners in the hands of the Allies, second, deserters, third, dead left upon the battlefield after a German retirement. The number of prisoners is, of course, known to the Allies with precision; the number of deserters is negligibly small, the devotion and patriotism of the German people being answerable for that. After deducting the known number of prisoners and a small percentage for desertion, it is certain that the remainder represents a number of Germans who, though dead, appear under the category of "missing." The total figure thus reached is 160,000. Adding this to the official list of 651,768 gives a total of 810,000 dead, up to and including the last day of January, 1916.

Having established that figure by the government's own statistics, Belloc proceeds to apply certain tests of accuracy which certainly seem to indicate that the published lists do not represent the total losses, by death, of the German Army. The method used was to check the official lists by comparing them with lists published by private authorities in Germany—trade unions, professional corporations and the like. These include parochial lists drawn up in the villages and published with legitimate pride as proof of patriotism, lists of the dead drawn up by unions of various kinds, religious and industrial, "roll-of-honor" lists given from time to time by large employers of labor, and, finally, the lists published by large clubs and associations formed for purposes of sport. All of these lists must be correct, because they are based upon the notifications given privately by the government to families when one of their members is killed.

Now a comparison of the private with the official lists reveals the very significant fact that for the first few months of the war the two lists practically agree. At the beginning of the winter of 1914, however, a grave disparity appears, and continues through 1915. The death rate established by the detailed private lists rises regularly and uninterruptedly, whereas the course of the death rate drawn from the general public and official lists as regularly declines. The conclusion, says Belloc, is inevitable: the private lists give the true death rate, the public lists, although at first carefully and fully maintained, give as the year proceeds figures less and less reliable.

Instructions were given in compiling the private lists to make sure that the data were gathered from widely separated points in Germany, and the greatest care was used to avoid any partial effect of trade, race or locality, the object being to obtain a combined result that would be thoroughly representative. By adding the shortage in the official lists, as shown by the more accurate private lists, it was found that the total of 811,000 dead, mentioned above, would have to be raised on December 31st, 1915, to over one million.

The most convincing proof that the German government, for military and political reasons, is endeavoring to conceal from the German people and from the world at large the extent of the German losses will be found in a study of the statistics of prisoners now in the hands of the Allies. A list was drawn up by the French authorities, giving the names, regiments, etc., of a great number of prisoners drawn from German units which had never left the front upon which they were originally engaged. This list was compared with the names appearing in the German lists of prisoners. The difference was over 69 per cent, that is to say, that very nearly 70 per cent of the names standing upon the French lists and representing prisoners actually in the French camps were found to be omitted from the German lists.

Adding to this total of one million the corresponding number of wounded (as shown by the ratio of wounded to dead established by the statistics of the present war), and making a liberal allowance of between 50 and 60 per cent of the wounded returned as once more efficient to the front, Belloc estimates that, at the very minimum, over three and one half million men had been permanently lost to the German fighting forces by January 1st, 1916, leaving only five and one half million out of the original nine-million maximum possible recruitment of German men effective for war.

Centennial of the Coast Survey

THOSE readers of the SCIENTIFIC AMERICAN who think that the broad and valuable scientific work carried on at Washington under the auspices of the National Government is a modern development, will be interested to learn that the United States Coast and Geodetic Survey celebrated on April 5th and 6th the centennial of its establishment. It is, of course, obvious that a maritime nation must have available a complete knowledge of its coasts and the character of the adjoining sea bottom, especially the location of reefs, shoals and other dangers to navigation, the rise and falls of the tides, the direction, strength of the currents, and amount of magnetic disturbance. Even in the early part of the nineteenth century, when the shore line of the United States was far less than to-day, the importance of an accurate knowledge of the coast was appreciated, and accordingly the Congress in 1807 authorized the establishment of a National Coast Survey. A plan was submitted by Ferdinand R. Hassler, a Swiss engineer, who had emigrated to the United States in 1805 and had been acting professor of mathematics at the United States Military Academy and professor at Union College. This plan was not put into effect until 1811, and actual field work was not actually begun until 1816.

The Bureau thus established had its varying vicissitudes, but the general plan of Hassler, approved by President Thomas Jefferson, was carried out, broadened and developed. It is under the direction of a superintendent, who supervises both the field and office forces into which the work is divided. The field officers comprise 64 assistants, 29 aids, 11 magnetic observers, 4 nautical experts, 14 tide observers, 59 mates, engineers, surgeons, deck officers, etc., 345 enlisted men, and an average of nearly 100 additional employees. The office force consists of various administrative officials, compilers, draftsmen, engravers, instrument makers, printers, etc., numbering 160, for not only does this department receive records and work them up but it actually constructs and prints the charts from the original surveys.

Unfortunately, the importance of surveying newly acquired territory or State lines and fixing boundaries by permanent marks, after those positions have been determined astronomically, has not always been realized. Frequently there have resulted difficulties whose settlement involved direct financial outlay far greater than would have been required for the adequate support of the Coast Survey in the first instance. Thus in the case of the controversy between the United States and Great Britain over Alaska, had the boundaries of that territory been determined with precision and marked with monuments immediately after its acquisition from Russia, there would have been no opportunity for dispute regarding the actual limits following the discovery of gold.

The actual geographic work of the United States Coast Survey is based on a system of main and secondary triangulation, which covers the entire United States. On the Atlantic Seaboard the Survey has carried out a complete scheme of primary triangulation while a second extensive system of triangulation extends across the continent along the 39th parallel of latitude and connects the surveys of the two coasts, furnishing a basis for the surveys of the thirteen States through which it passes. Other triangulation systems have been extended throughout the United States and expanded in various individual States. From the primary and secondary triangulations a tertiary triangulation has been developed along the entire Atlantic and Gulf coasts and Porto Rico, and the Pacific coast, except Alaska, where work still is in progress, as is also the case in the Philippines. The astronomic positions of various points on the systems of triangulation have been determined by the use of the zenith telescope for latitude and the telegraph for longitude. The familiar charts issued by the United States Government show hydrographic data, including all harbors, channels, buoys, etc., as well as the topography for a few miles inland, and in the case of rivers and other indentations to the head of tide water. Deep sea soundings are made and tidal records are compiled and published. Terrestrial magnetism is another field in which the operations of the Survey have been carried on, and the study of the force of gravity has been the subject of a number of important investigations. Lines of precise levels cover the United States in a network in which the Coast Survey has coöperated with other government agencies and several railways, and this work is being prosecuted from year to year with increased importance.

Few Bureaus of the Government can show a record of such continuous efficiency as the Coast and Geodetic Survey, and its future activities should receive from Congress the full and sympathetic coöperation they deserve.

Radio Communication

Seizure of Amateur Stations by Government.—More than 25 amateur wireless stations in and about the city of San Antonio, Texas, have been dismantled by Federal officers acting on instructions from the Department of Justice. The cause for the action is said to have been the interference of these amateur stations with the United States Army portable sets in Mexico.

Vessels Equipped with Radio Apparatus.—According to the Lloyds Register for 1914-15, there has been a steady growth in the number of vessels equipped with wireless apparatus and submarine signalling installations. There are now on the Lloyds registry of the world's merchant marine 2,939 vessels equipped with wireless apparatus, and 947 provided with submarine signalling systems.

Radio Communication Charts.—The superintendent of the Naval Radio Service announces that commencing with March, a complete communication chart is being issued to the public gratis upon request. This chart includes the various merchant vessels in North and South American trade, the time and date they may be reached by radio, the coastal stations through which traffic should be routed, and rates for radio landline service.

Improved Radio Signal Receiver.—It is reported in *El Imparcial*, one of the leading dailies of Madrid, that the Minister of Public Works, after examination and report by the Centro Técnico de Aeronáuticos, has approved a radio signal receiver of a type that does away with the usual ear pieces. It is said that the radius of the new apparatus is in excess of 5,000 kilometers (the kilometer being the equivalent of about ⅝ mile) and that it is contemplated to institute radiographic service between Spain and the United States.

Radio Telephone Experiments in the Navy.—It is learned that radio telephone experiments have been conducted during the winter maneuvers of the Atlantic fleet off Cuba. For the purpose wireless telephones have been installed on the "Wyoming," Admiral Fletcher's flagship, and on the "Texas." These instruments have been used in sending messages to other units of the fleet, which, while not equipped with radio telephone apparatus, have been able to receive the messages with their wireless telegraph receiving sets. It appears that the transmitters are based on the results of the American Telephone & Telegraph Company's successful radio telephone experiments, in conjunction with the Western Electric Company.

Standardization of Wireless Apparatus.—The progress made in wireless telegraphy during recent years has not been so much in the direction of new inventions and startling developments as it has been in the standardization of existing apparatus. It is not so long ago that every ship station, with but few exceptions, was unique, although designed, installed and maintained by the same wireless telegraph company which operated sets on numerous other ships. The result was that repairs were difficult, because of the lack of standard design, and, incidentally, the cost of the sets was greater in comparison to their actual value than if every part had been standardized and made in quantities. During the past one or two years the leading American wireless companies have been exerting every effort towards making their installations as simple as possible, of standard design and, moreover, with interchangeable parts. No longer is it necessary for a radio operator to acquaint himself with some particular set of apparatus to which he may be assigned, since all sets are alike, and if he has handled a ship station elsewhere he is prepared immediately to operate any other ship fitted with the same system.

Effect of Imperfect Dielectrics.—The loss of electrical energy in an antenna is caused by the resistance of the antenna, according to a recent announcement made by the Department of Commerce. The so-called radiation is a measure of the portion of the energy usefully dissipated in the emission of the electromagnetic waves. The remainder of the resistance causes a useless dissipation of energy that should be reduced to a minimum. It has been previously noted that, in the region of the longer wave-lengths, the resistance of an antenna increases with increasing wavelengths and the explanation has been offered that this is caused by dielectric absorption or a loss of energy such as that which takes place in a poor condenser and that it is probably caused by the ground. However, the Bureau of Standards finds that the loss does not take place in the ground, but in poor dielectrics in the electric field of the antenna such as wooden masts, trees, insulation, etc. Running the leads into a building may increase the resistance unless the interior walls are covered with metal screen and connected to ground. It is important, therefore, to reduce to a minimum these sources of energy loss in designing an antenna.

Science

Observing Air Currents with a Telescope.—Prof. W. H. Pickering, in charge of the Harvard Observatory, at Mandeville, Jamaica, describes in the *Monthly Weather Review* the effects of passing hurricanes in that region upon the upper air currents as observed by the following method. If we point a telescope on a bright star, remove the eyepiece, and place the eye near the focus, we perceive a bright disk crossed by dark fluctuating dots or lines. These are due to currents in our upper atmosphere. The same result is obtained if, instead of removing the eyepiece, we draw it out a few millimeters beyond the focus. In the latter case, if we determine the number of millimeters we can readily compute the altitude of the current whose motion we are observing. The dark lines travel longitudinally in the direction followed by the current. At Mandeville the "seeing" is never very bad, except when a hurricane is in the neighborhood. At such times the mode of observation above described gives timely notice of the approach of a hurricane, and also furnishes a means of studying the movements of the upper currents in connection with these disturbances.

The San Blas Indians, who occupy the north coast of the Republic of Panama from a point a few miles west of the Gulf of San Blas to Cape Tiburon, on the Columbian frontier, are well known to dwellers in the Canal Zone, which they frequently visit, but are by no means inclined to receive visits in return. They have resolutely maintained their independence, preserved their territory from foreign exploitation, and kept their blood and racial characteristics pure. Mr. J. G. Steese, writing of these people in the *Bulletin* of the American Geographical Society, says that they keep up the custom of requiring the traders who visit their coast to return to their ships at sundown. There has been friction of late between the Indians and the Panama government, and consequently the former are at present flying the Colombian flag. The President of Panama made a special trip of conciliation to the San Blas coast last spring, but most of the Indian chiefs refused to receive him. A result of this trip however, was the establishment of a custom house on one of the islands of the Gulf, where all trading boats must clear, and this will give the government a stronger hold upon the tribesmen.

Practical "Probabilities" in Meteorology.—Although it is not yet possible to make trustworthy predictions of the weather for a coming season, climatic statistics furnish information bearing on this subject that is of practical importance to the agriculturist and others. A suggestive paper read by Mr. W. G. Reed, of the Office of Farm Management, U. S. Department of Agriculture, at the last meeting of the Association of American Geographers, brings out the value of knowing the "business risk" from unfavorable weather as shown by a "probability curve" based on statistics of past years. The author exhibited a chart giving the dates after which at various places killing frost will occur one year in ten, on an average. Similar charts have been drawn for the first autumnal frost, and also for the probable duration of the frostless period four years in five. This idea of showing what will happen "in the long run," together with the percentage of probability, is of great practical value and deserves to be more generally emphasized from the practical as distinguished from the academic point of view. It may be noted that the interesting series of "drought charts" published a few years ago by the Russian agriculturist meteorological service embody the same idea.

The Harmful Effects of Cosmetics are discussed by M. I. Wilbert in *Public Health Reports*. Unfortunately the Federal and many of the state food and drug laws do not apply to preparations of this class unless curative claims are made for them. Hence unscrupulous manufacturers make use of deleterious and dangerous substances in their preparation. Wood alcohol is one of the many poisonous drugs that have been found in so-called "cosmetics" by the chemists in charge of state laboratories. Of the potent drugs of a possibly harmful nature used in "hair restoratives" the writer mentions lead acetate, silver nitrate, paraphenylene diamine, and resorcin. Beauty washes and face enamels contain flake white or lead carbonate, diachylon or lead plaster, corrosive sublimate, calomel, bismuth subnitrate, etc. Flake white is generally recognized as the most common cause of industrial lead poisoning, and there is evidence that many forms of disease and nervous disorder may be due to the use of cosmetics containing lead. The salts of mercury and bismuth are also dangerous unless used with due care. Lastly, cosmetics, as ordinarily used, tend to clog the pores or irritate the skin and interfere with its normal action. Mr. Wilbert's arguments are, however, not directed so much against the use of cosmetics in general as against the frauds practiced by a considerable number of manufacturers.

Invention Notes

Patent Granted on Color Photography.—A patent was recently granted by the United States Patent Office to Frederick E. Ives covering the process of color photography which was recently described in these columns. The patent covers moving picture films as well as prints in color.

An Economical Refrigerator.—Some of the most recently built houses are being equipped with a cooling cabinet which is designed to fulfill the functions of the refrigerator to a very great extent if not entirely. It makes use of no ice, chemicals or machinery, but its interior is maintained at a temperature sufficiently low to keep viands in good condition for a moderately long period to answer all domestic purposes. The cabinet is kept cool by a circulation through it of the cold water used for the ordinary household purposes. This water circulates about each of the chambers of the cabinet and the temperature is maintained at an even rate which can always be relied upon. After its passage through the piping of this device it is discharged at the regular faucets.

Splints Which Are Adjustable.—An improved splint for setting the broken bones of the leg, arm or shoulder blade, which has been recently patented by F. A. Sprague of Concord, N. H., is entirely of metal and has the advantage of extreme simplicity, further, it is capable of adjustment while in place. Concave splint pads shaped to fit the contour of the limbs are arranged in pairs with a stretching mechanism between them by which the pads are separated or drawn together as desired. Thus, after the cast is all on, if an X-ray examination should disclose the fact that the broken ends of the bone were not in perfect apposition, the ends may be brought into alignment by shortening or lengthening the adjustable connection between one or the other of the splints.

Steam to Clear the Soil.—A new piece of agricultural apparatus has been developed for the purpose of combating the destructive bugs and undesirable vegetable growths by an application of steam to the soil penetrating some distance below the surface. The machine carries a steam generating plant and moves over the surface on a large drum, the periphery of which is staggered with protruding steam outlets in the shape of blades or spines. As the apparatus is drawn over the ground the spines imbed themselves in the soil and while in this position the steam is released and penetrates the soil for some distance around the outlet, killing the worms, larvae and bugs and the undesirable crop of weeds which seed themselves from one season to another.

Pedal Attachment for Washstands.—Hot or cold water flows from the same spigot and the handles on the washstand faucets have been rendered obsolete by a new arrangement which provides a foot control for the flow of water. Sanitary cleanliness is the prime object of the new arrangement, but convenience is also an important consideration. In the state of Illinois it is compulsory to supply running water in factories and such places and similar measures have been enacted or are under consideration in other states, the object being to prevent the contamination which is likely to occur when the wash basin is used in common. The pedal attachment is placed under the washstand a few inches inside of the front line and to one side, preferably the right side, and connections are made with two valves located under the washstand. The location of the pedal is convenient to the foot and the pressure exerted in the center of the pedal causes a mixture to issue from the spigot, while if the foot is shifted to the right or left the temperature is made hotter or colder as desired.

Revolving Table for the Book Bindery.—In book binding establishments where there is a variety of work to be performed there has not been introduced as yet a satisfactory device for gathering the signatures mechanically. At the present time this work is generally performed by girls, who walk about a large room, picking one part of the work after another from piles placed around the room. This work is so severe that the work of gathering the leaves is limited to the pedestrian abilities of the females. The capacity and comfort of these girls working in a Louisville, Ky., establishment have been increased by a revolving gathering table which has been designed by the manager of the company, Edward Gottschalk. The table is twelve feet in diameter and will accommodate comfortably ten gatherers, but several more could be crowded around it in an emergency. The table is driven by a two horsepower motor. The gatherers are seated around it, and as the piles of sheets go by they remove those desired and assemble them. This table is large enough for all ordinary work. The Kentucky Statutes consisting of 2,000 pages, was handled with ease. With a double-decked table it would be possible to handle a dictionary.

Two Recent Developments in Electric Illuminating Devices

TWO most interesting developments of electric lighting have been made recently, one of them in the direction of increasing the convenience of certain types of electric lamp and the other in improving the quality of the product

W A Darrah an engineer of Mansfield Ohio is responsible for some changes in the design of the arc lamp through which the inconvenience of daily attention such as cleaning and renewal of the carbons is overcome The lamp has been demonstrated at several meetings of electrical organizations and the principle involved and the results achieved have been commended by those who have had the opportunity of studying it The lamp has been hailed as the successor of the arc lamp, and it has also been pointed out that under certain conditions it may take the place of the incandescent lamp

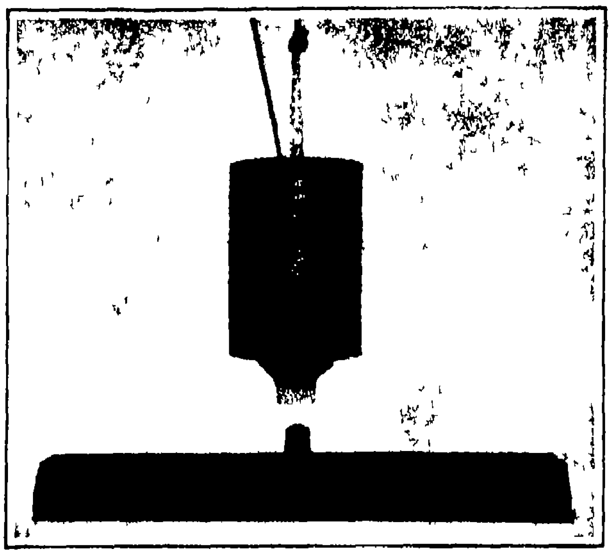
The lamp consists of a glass tube about the size of an incandescent bulb At the lower end of the bulb a solid tungsten electrode about a quarter inch in diameter is supported by a small tungsten rod. A movable tungsten electrode attached to an iron core is placed within the upper neck of the tube and arranged to draw an arc from the lower electrode A flexible conductor connects the upper electrode with a seal in the upper part of the lamp The bulb is exhausted of air and a given amount of titanium tetra-chloride gas mixed with bromine gas is admitted The bulb is then sealed from the air after the manner of an incandescent lamp A coil of wire adjacent to the iron core serves to lift the iron core thereby separating the electrodes and drawing the arc. The lamp is thus entirely automatic and may be turned on and off by merely operating a switch

Since the electrodes are kept away from the oxygen of the air, they are not consumed as is the case of the ordinary arc lamp The electrodes of the new lamp last for a long time The vapors, which have been put into the lamp, make the arc intensely luminous and very stable, they are consumed at a very slow rate and by reason of the construction, the lamp remains clean and requires little more attention than an incandescent lamp.

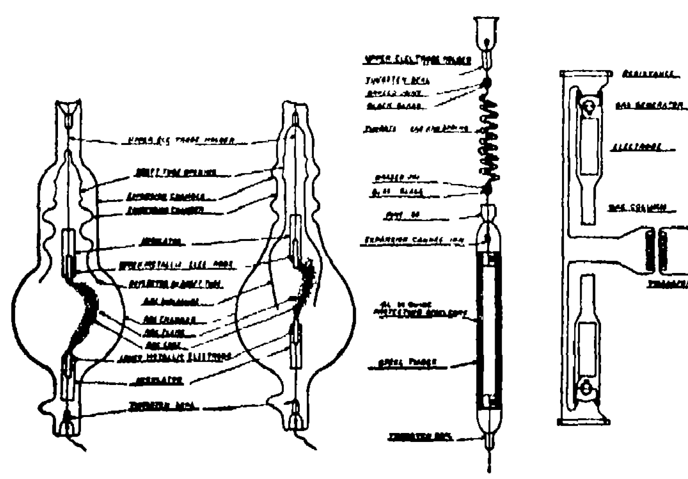
In operation the lamp gives an arc from 2 to 5 inches long depending upon the voltage of the operating circuit. The arc is about one eighth inch in diameter and has the appearance of an intensely bright white, incandescent filament, being very steady, with almost no flicker The efficiency is considerably better than that of the present incandescent lamps and somewhat better than the best modern arc lamps The light has exactly the same spectrum as the light from the north sky on a clear afternoon A spectroscopic analysis of the light shows that it is substantially daylight with the exception of a few dark lines across the spectrum, which are probably due to a slight absorption of the vapor in the lamp

An important step in the production of artificial daylight is a new form of the Moore vacuum tube, recently shown before a meeting of the Electro-Chemical and Illuminating Engineering Societies. The new lamp is suitable for making absolutely correct color determinations and is applicable to a very wide field, but its particular usefulness is in enabling the dye shops of the great textile industries to run night shifts. Elaborate spectrophotometric investigations have shown that all articles when viewed solely by the light of the tube lamp have exactly the same values as when viewed by the light of a clear sky—all dyers and color experts agree that the standard light for color judging is that entering a window from a clear north sky at an angle of about 45 deg at mid afternoon with a clear sun shining in the south. The tests referred to were made with dress goods, silks, meats, flowers, and samples from the National color card of America

In one of the accompanying illustrations appears one of the new color matching lamps. The straight tube lamp is contained in an elongated sheet metal case which, however, is provided with a screw base similar to that used on the larger sizes of incandescent lamps. Instead of the lamp being fed carbon dioxide gas by means of an auto magnetic feed valve, it is generated automatically within the tube itself Near each electrode is placed a small bulb about an inch long containing calcium carbonate from which emanates carbon dioxide gas when the resistance wires, imbedded in it, become heated to exactly the proper degree by reason of their being connected in shunt to the gas column The gas column appears as a solid bar of light of intense whiteness. The foot candles available near the tube is over 200, thereby making the apparatus practicable for the very closest color discriminations, so it is claimed



Two views of the new form of electric arc lamp which contains its own carbon dioxide generating apparatus



Constructional details of the new enclosed tungsten arc lamp and the color-testing tube lamp that generates its own gas

Portable Apparatus for the Detection of Combustible Gases in Air

By George A. Burrell

THERE recently has been devised by the personnel of the Bureau of Mines a portable gas detector which can be used for detecting methane—more commonly known as fire damp—in mine air, as well as for detecting natural gas in air, coal gas in air, gasoline vapor in air, water gas in air, acetylene in air, carbon monoxide in flue gas, and for the detection of other combustible gases in air

Ever since coal mining has been actively engaged in, technologists have ceaselessly endeavored to perfect methods for gas detection in mines. But despite these endeavors, the safety lamp remains to-day the universally used device for the quick testing of mine atmosphere to determine their methane content. With the safety lamp percentages of methane as low as 1½ or 2 per cent in mine air can be detected by skilled observers, but it is highly desirable to detect proportions less than these, and also to eliminate as far as possible the personal element Many other devices have been exploited, but the fact that they are not widely used is proof that they do not fulfil the needs.

In working on the problem of gas detection in mines, the author endeavored to develop something that would be superior to the safety lamp, as regards ruggedness, simplicity, weight and accuracy It is believed that this has been accomplished, for the new apparatus is 10 to 20 times more accurate than the safety lamp, is lighter in weight, is more rugged and is fully as simple of operation

A photograph of the gas detector appears in Fig 1. The parts are of aluminum and brass, except the stout glass at the right A sectional view of the device appears in Fig 2 The instrument may be considered to be a U tube of which the limbs A and B are two branches Communication is made between the limbs at a point near the bottom

To start a series of determinations a brass cap is removed and water poured into A until it rests in the tube B at the point D, the zero point on the scale The water will then seek the level E in the tube A

To make a determination of combustible gas in air, say of methane in mine air, one blows into the tube F by means of a rubber tube (which is not shown in the drawing), thereby depressing the water in B to some point in H and filling the combustion space above E with water One can tell when this combustion space is filled with water by hearing a slight click when water strikes the valve M Next, the instrument is raised to the place where the sample is to be collected and the water allowed to seek the former levels at D and E The water in falling to E sucks in a sample of the air to be tested Next, the valve M is closed and the platinum wire N electrically heated The methane in the combustion chamber burns to carbon dioxide and water, thus

$$CH_4 + 2\,O_2 = CO_2 + 2\,H_2O$$

i e, contraction in volume of the sample occurs corresponding to the amount of methane originally present in the sample. At the end of 1½ minutes the electric current is turned off and the instrument shaken to cool the gases in the combustion space and bring them to the same temperature as the gases were at the beginning of the test. The water in the combustion space will then rise to take the place of the burned-out space and fall a corresponding distance in the glass tube B, *i. e.*, fall to a point on the graduated scale that will show the percentage of methane originally in the sample. A previous calibration, once and for all time, fixes the proper graduations on this scale. The latter carries four graduation columns, one for methane

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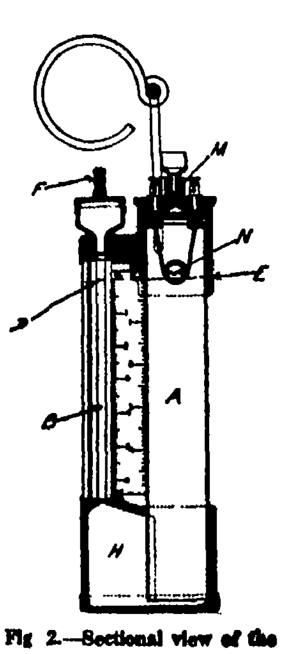


Fig 2.—Sectional view of the portable gas detector for miners

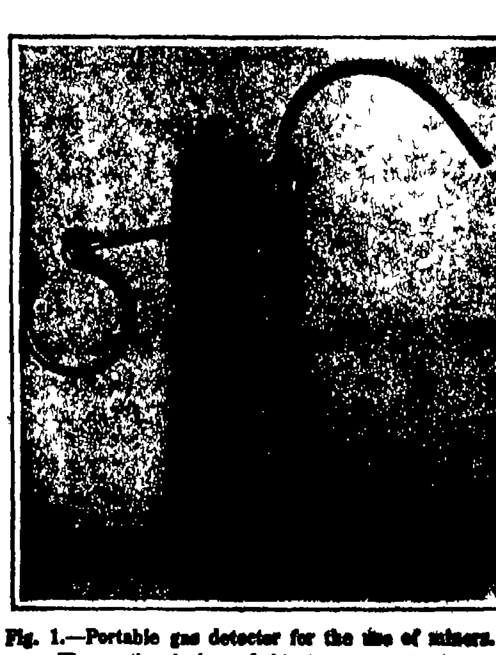


Fig. 1.—Portable gas detector for the use of miners. The sectional view of this type appears at the left

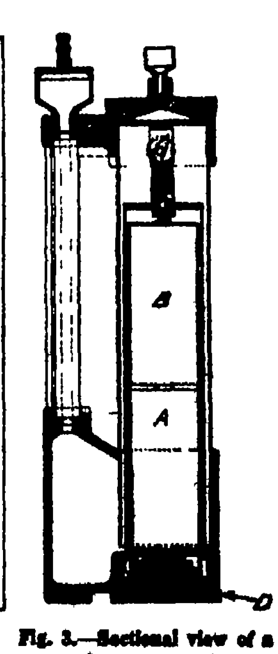
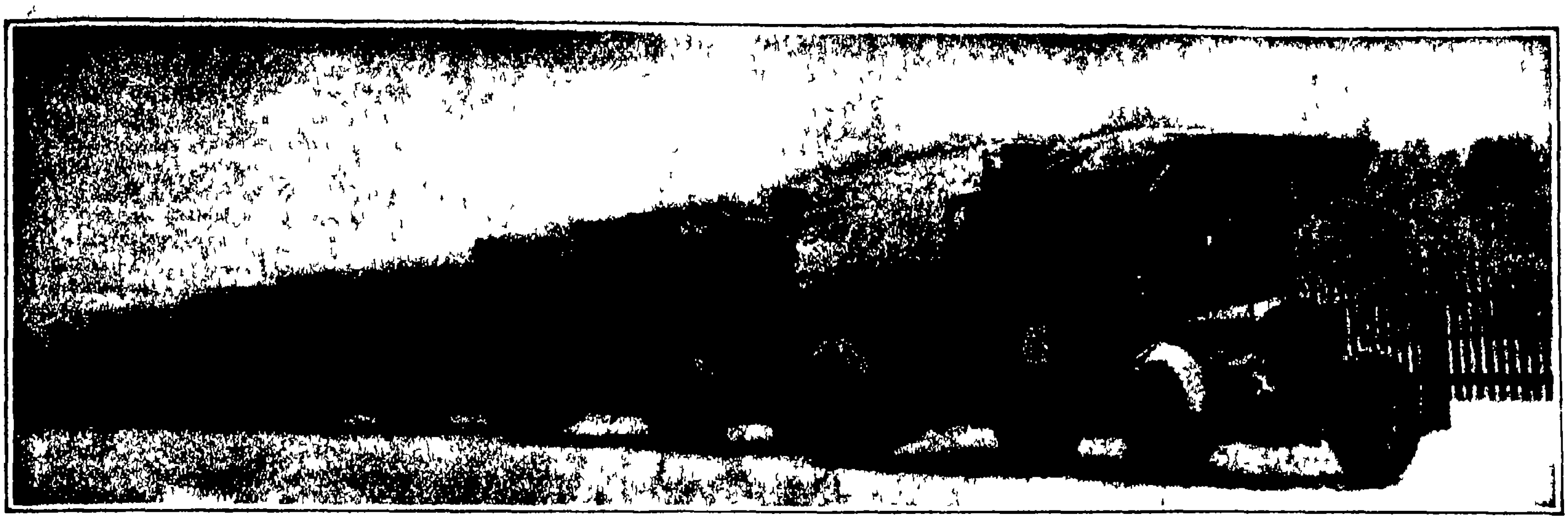


Fig. 3.—Sectional view of a gas detector containing dry cells



The four load-carrying trucks led by the repair truck, parked in the open over night during the camp at New City

Civilian Motor Trucks as Army Supply Trains

A Test Run Under Adverse Conditions to Prove Practicability of Heavy-Capacity Units

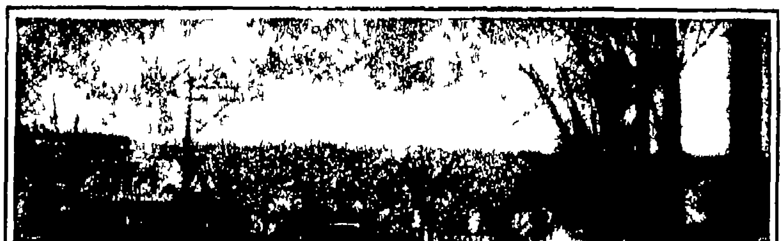
By Joseph Brinker

PROOF of the practicability of heavy motor trucks for the transportation of army supplies in this country in time of war was the outstanding result of the trip of a fleet of fully laden 5- to 6-ton trucks recently held in regular army convoy fashion over the roads of southern New York and adjacent New Jersey. This in view of the fact that the United States Army recommends a 1½ ton truck as the most suitable for military work. The trip was the first of the kind ever held in this country wherein civilian truck owners volunteered their vehicles in a genuine endeavor to determine exactly what problems would have to be encountered by commandeered vehicles in case of war and the best manner in which to solve them.

The run was held by the Motor Truck Club of America, a national organization of motor truck owners and operators, with headquarters in New York City. All the trucks were volunteered by members of the club, who also provided the drivers and all the necessary equipment to make the convoy a self sustaining unit. Army fashion a commander of the fleet and his assistants were appointed from the club, together with passenger cars to enable them to accompany the train, and others for their orderlies to run back and forth along the line to give orders.

The route began at Stephens's coal yard in the Bronx, New York City, and ended at the horse farm of Squadron A, N. Y. National Guard, at New City, N. Y., a distance by road of 32 miles. The trip began at 3:30 P. M. on Saturday afternoon, April 8, the objective being New City, which was reached at 9:40 o'clock that night. Camp was made there for the night and the return trip made on the following Sunday. The time of the run on Saturday afternoon and Sunday was selected so as to cause as little financial loss as possible to the owners of the trucks, for the vehicles are employed in purely commercial pursuits during the rest of the week among them coal transportation.

It snowed a veritable blizzard for almost the entire trip which made the soft country roads regular quagmires in places and hid the ruts until the truck wheels had already fallen into them. The grades encountered varied from 5 to 7 per cent, yet the ratio of the running time to the total time on the road was 86 per cent, indicating the great value of trained drivers and that the success of truck use is largely dependent upon their skill and past experience.



The fleet ascending the 7 per cent hill leading up from the valley of Englewood to the top of the Palisades, in New Jersey

The motor truck train coming down the hair-pin road leading from the top of the Palisades to the foot of the hill at the edge of the Hudson River

That the results of the trip might not go unnoticed by the army and militia authorities Major General Leonard Wood, commander of the U. S. Army, Department of the East, and Major General O'Ryan, commander of the National Guard of New York, were invited to attend. Both sent representatives well versed in army transportation, the former Capt. Gordon Johnson, and the latter, Capt. T. H. Shanton. Both were much impressed with the great mobility of the large-capacity motor trucks.

The fleet was made up of six large motor trucks five of 6½ tons' capacity and one of 5½ tons. In addition, there were passenger cars for the army officers, for the civilian commander of the train and his two lieutenants and for three orderlies, one of whom acted as a scout. The 6½ ton trucks were donated by the Olin J. Stephens Coal Co., and four of them were loaded to capacity with coal to take the place of ammunition or supplies that would have to be carried in time of war. The other 6½ ton truck acted as a repair vehicle and was loaded with spare front and rear truck axles, a separate radiator and every other small part which might need replacement in case of an accident. It was also loaded with planks, jacks, rope and tackle and all other tools which might be necessary to extricate one of the vehicles if it became mired. The sixth truck of the train, a 5½ tonner donated by George H. Pride, a Gotham transportation expert, acted as a commissary vehicle. It carried tents, kitchen equipment and cots loaned by Major W. R. Wright, Squadron A, for the entire personnel of the train, in addition to food.

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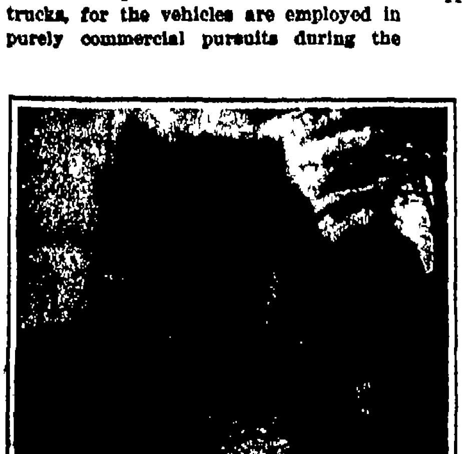
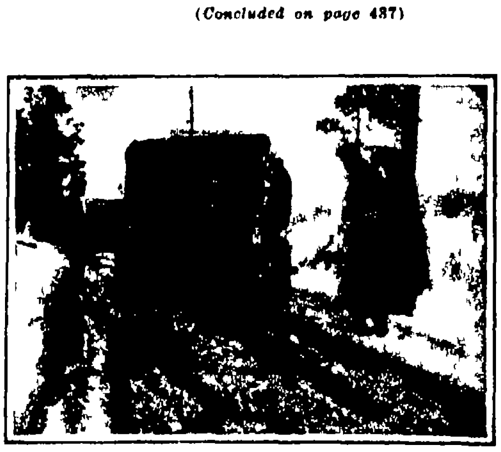


Motor truck mired as a result of its going to the side of the road to let other vehicles pass

The "Bassett" army field kitchen preparing the morning meal for the personnel of the motor truck train before returning to New York City



Difficulties encountered on a bad stretch of country road, in which the tow line was much used

Strategic Moves of the War, April 14th, 1916

By Our Military Expert

THE great German assault upon Verdun has lasted since Feb 21, apparently with no end yet in sight. The massing of artillery, the rush of storming divisions and the employment of every means of warfare known to the modern day have each been in the superlative, there has been no action in all history which can be compared with the battle of Verdun. It is not a battle, it is not a siege, the two are combined in one sanguinary in the extreme.

Foreign as well as local military writers, soldiers trained in the art of war and strategians of high degree, freely confess that they are unable to definitely state what the object of the German Staff seems to be while whole army corps are being hurled, in the face of huge losses, against the serried guns of Verdun. The point is rather remote from Paris. It scarcely seems to be a drive upon the French capital. And while the Verdun salient without doubt establishes a certain menace against Metz in the event that the Entente begins a determined drive in the course of time, the German losses so far encountered seem utterly disproportionate to the possible gain of eliminating the menacing salient.

Merely for effect upon doubting neutrals and the shaking of enemy *morale* maintenance of the attack for a few weeks would have had as much effect as this sustained effort. If the German Staff hoped to provoke a premature launching of an offensive by the Entente, it was demonstrated days and weeks ago that the hope was doomed to failure, for with the exception of sporadic activities on the Russian front no semblance of a counter-offensive has been witnessed.

It is very evident that for some reason however, Germany seems willing to pay the price, to make enormous sacrifices at Verdun to gain the city and fortress. What the reason is no one not in the confidence of the German Staff may know. For fifty two days—up to the date of this writing—the general attack has continued with brief intervals of inactivity, during which time positions gained were consolidated and preparations were made for resumption of the attack.

The sector held by the French about Verdun constitutes a salient, a weakness for defensive purposes, with the constant danger that one or both sides may be crushed in, bagging the principal defending force and striking a severe blow at *morale*. It appears to many as though the general safety of the French line would be better served were the position given up and the line straightened along the Argonne. The line would certainly be shorter more easily manned, with defensive positions existing along its length at least as good as those about Verdun.

At first glance at the map, Germany appears to have gained considerable territory since the initiation of the offensive. The French line which extended from the *Bois de Cheppy* west of Avocourt, to the vicinity of Malancourt north of the Forges brook, to the Meuse at a point between Consenvoye and Brabant, has been pressed back, west of the Meuse.

East of the Meuse the line continued through the wooded slope eastward until about three miles north of the *Poivre* ridge, then it bore to the southeast between Ornes and Maucourt through Fromezy almost to Warq thence southward until the town of Fresnes was included within its embrace.

To-day the line begins west of the Meuse at almost the same place as specified above, but the Bois de Avocourt has been practically cleared of French troops, who are pressed back upon the westerly slopes of the famous 304 metre hill. At Haucourt the line swings almost eastward, still enclosing the hill sways southward a trifle to each side of the southern reach of the Forges brook, thence around Le Mort Homme, upon the northeastern slopes of which the Crown Prince is reported to have gained a tenuous foothold. The line then extends through Cumieres to the Meuse.

Three days ago the French evacuated the Bethincourt salient. The Forges brook practically bisected it, hills stood to either side and the position was a low one commanded by the neighboring eminences to a large extent. There was constant danger of a strong attack crushing it in, with disastrous results, and General Petain, the Sector Commander withdrew in safety to higher ground between *Le Mort Homme* and Hill 304.

East of the Meuse the French hold but a slice of the *Cote de Talou*, that tongue of hillside which projects into the great bend of the Meuse north of Verdun. The line extends to the *Cote de Poivre* most of which is in German hands. South of Louvemont the line bends below Douaumont and its dismantled, destroyed fort, to loop about Vaux thence to Damloup, where it follows the junction of high ground and low, behind which perch the barrier forts of the Verdun *enceinte*, covering the railway from west of Fresnes to its junction with the Verdun Etain road near Eix.

Compare the two lines, that which existed when the battle commenced, on February 21 with the present one. It will then be seen that at only two points, Douaumont and Vaux, have the Germans, after more than seven weeks, come in contact with the Verdun line of defense as indicated by the fort positions. Most of the territory between the two lines has been voluntarily given up to the Germans in the face of their attacks. It merely constituted the advanced position.

But forts, in these days of warfare are not the impregnable defenses they were two score years ago. The gigantic artillery of modern days is almost irresistible. The first days of the war taught the futility of armored cupolas. It is reported that all the Verdun forts east of the Meuse have been dismantled and stripped of their armament, which has been placed in position to the west of the city. From the present positions the Germans can batter the city of Verdun to a pulp if they so desire but it can have little effect upon the lines now existing should they elect to do so. Instead of forts the battle is being fought out by artillery heavy and light, which strives to obliterate the French trenches ere the launching of the infantry attacks. And the defenders can merely cower amid the devastation until the storm ceases, when they dig themselves out to meet the assault of the infantry lines.

It seems the consensus of opinion among military men in this country that there are only two *armies* engaged in Europe to-day—the German and the French. England has 4 000,000 men under arms—but they do not constitute an army, merely a ponderous organization which has not yet found itself in its functioning. England will have an army in the course of time, but how soon no one can tell.

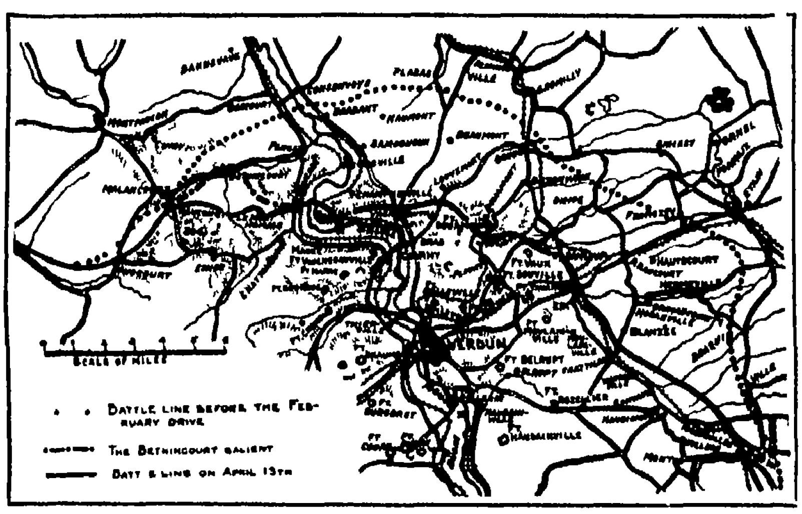
Germany began this Verdun attack with at least 400 000 men about three times as many as the French had available in or near the sector. With the throwing in of additional reserves, the German forces have probably reached 600 000. To meet this it is doubtful whether France has more than 300,000 or 350,000 all told in the sector, for the remainder of the line through France cannot be stripped although the English have taken over the French trenches as far south as the Somme.

Germany must have lost between 200,000 and 250 000 men in her attacks. This includes all incapacitated for immediate use. France has probably lost about half as many—possibly a trifle more—and the end is not yet in sight. It is not for any one to criticise the arrangements of those masters of their profession, the members of the German General Staff, they must have their reasons for the attack, obscure as they may seem to the outside observer. The fact remains that the most monumental assault of the war is being maintained desperately. And it would be of absorbing interest to know just what is behind it all.

It is far from being an impossibility that Verdun will fall. The attacks have been progressing westward steadily, mile by mile. If the Le Mort Homme position is gained then the next step will be calculated operation against Hill 304, across the Forges brook. With the employed principle of flanking, which has resulted in the Mort Homme lodgment, extended to the 304 assault, in all probability the district west of Avocourt will come in for a share of attack that 304 may be flanked, perhaps isolated. Hill 304 is supposed to be the key to the position to the northwest. Should it fall into German hands, if an attack is pressed home with the determination which has characterized the preceding ones, the great salient side to the northwest of Verdun may be caved in, the direct railroad to Paris threatened or taken, and, unless the salient is evacuated, the whole French force of defenders be taken.

Paris professes to feel secure in the ability of the French to hold Verdun. It is as possible that Verdun will hold out as that it will fall. In either case, so far as the present situation is concerned, France will rather appear the gainer, for with the exception of the blow to national pride and the possibility of shaken *morale*, evacuation of the salient will shorten the French line, which can then be more easily defended, requiring direct frontal attacks to make any headway with the elimination of flanking. And if Verdun holds out—it will have held out.

Well into the eighth week of the Verdun assault, there seems to be no diminution of the strength of attack, with due allowance for the preponderance of heavy German artillery, no let up in the grimness of defense. There is a possibility that with the coming of propitious weather a great allied counter movement may be begun, or the Entente may feel secure enough to let Germany butt against her defenses until later. Take your choice.



Map of Verdun showing the progress of the German offensive

The Current Supplement

THE mysteries and wonders of our globe are never-ending subjects of interest to everyone, and the article on *The Earth*, considered from a geophysical standpoint, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No 2103, April 22d, will be generally appreciated. When so many are discussing systems for the conservation of our national resources it is pertinent to inquire what other nations have done, and in this connection the article on *The Industrial Development of Japan* is timely. A paper on *Insects that Perplex Naturalists* reviews many strange features that have defied explanation. It is profusely illustrated. *Cable Codes of the World* describes the various systems of signs used for the electrical transmission of thoughts. An article that will directly interest many is the article on *The Development of the Automobile Differential*. This is written by an authority on motor vehicle mechanisms, and is fully illustrated by explanatory diagrams. *Scientific Bomb Dropping* describes instruments that enable these destructive explosives to be accurately dropped from fast moving aeroplanes and is accompanied by diagrams and illustrations. *A Notable Engineering Work* illustrates and describes one of the largest trestle railway viaducts on this continent. *Early History of the Anglo Egyptian Soudan* treats of the subject from an ethnological point of view, and contains many points of great interest. There is the usual assortment of shorter articles of varied interest.

A Correction

THE oblong form of projectiles came into use with the advent of the rifled gun. Originally, the head of these projectiles was hemispherical. This was about the year 1865. Through a typographical error, the caption below Fig. 4, of our article on The Extreme Ranges of Modern Guns (SCIENTIFIC AMERICAN of April 8th, 1916), gives the date as 1900. The error has been called to our attention by the author of the article, who wishes to have it made clear that the form of projectile shown in Fig. 4 is as yet somewhat in the experimental stage, the form shown in Fig. 8 being the standard type.

Enameled Wire

WIRE covered with an insulation of enamel has recently become very popular for certain electrical uses such as telephone wires in tropical countries. The Post Office Telephone Department insists that these wires shall stand an electrical pressure of 1,000 volts after immersion in caustic soda, sulfuric acid, nitric acid and hydrochloric acid for 48 hours each and in potash 35 minutes. With very thin wires it is difficult to coat the wire uniformly

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Retarding Tree Budding Electrolytically

To the Editor of the SCIENTIFIC AMERICAN

Appreciating the frequently recurring loss to fruit growers throughout the East and West, due to short, warm spells in the early Spring prematurely budding fruit trees, it occurred to me that if the budding of the tree could be retarded at such times, it would result in the saving of millions of dollars to the fruit industry, and, knowing the effect of electrolysis upon salts and acids, it seemed that it should be possible electrolytically to change the food substances that, while the circulation of the sap would not thereby be impeded, it would permit only the circulation of impoverished food properties, wherefore the maturing of the buds would be temporarily postponed.

Unfortunately, I have never been so situated, nor have I had the means at my disposal, to carry on such experiments to an exhaustive conclusion, but, realizing their importance (if my conclusions were correct), I attempted the experiment, under less favorable conditions than would obtain in the colder climates—i. e., in the Salt River Valley of Arizona, where extremes are seldom experienced. Notwithstanding this lack of climatic extremes, it seemed possible to conduct relative tests and demonstrate the value of the theory.

On January 8th, 1915, I chose two "Jordan" almond trees, of the same age (about four years) which had received the same cultivation and quantity of irrigation water during their life. In one of these trees a 1-64-inch hole was drilled in the trunk, 18 inches from the ground, a gold pin inserted therein and connection made therewith to the negative side of one dry battery giving a potential of 1.5 volts. The positive side was grounded to a rod driven into the ground about 2 feet from the tree trunk. Thus a circuit was established from the battery into the ground, into the root fibers, back to the negative side of the battery. The current flow was so slight as to be impossible of measurement with the instruments at hand. Therefore, on January 10th, four additional dry batteries, connected in series, were added giving a potential difference of eight volts. This voltage was found subsequently, to remain constant, showing a very slight, almost imperceptible current flow so small, in fact, as to be unreadable on the ammeter used. The current was permitted to flow continuously.

On January 17th (seven days after the addition of the four new cells) the buds on the untreated tree had developed one third larger, by measurement, than the buds on the tree upon which experiment was being made. It will be understood that when the experiment was begun the buds measured identically the same on both trees. Evidently the development of the buds upon the treated tree had been retarded very greatly by this feeble current flow.

In my opinion this current should have been withdrawn January 17th, since, after that date, there appears to have been a recovery from shock for, upon February 10th, the treated tree put forth a vigorous development of the buds and those upon the extreme tips of the branches were in bloom February 12th, whereas the buds of the untreated tree were uniformly developed and did not bloom until several days later. The lower buds, or all except those occurring at the tips of the limbs upon the treated tree, were retarded and did not come into bloom for some time after those upon the untreated tree.

There are two conclusions to be drawn from this experiment. First, that the current strength was not sufficient to change the nitrates, carbonates, and phosphates so completely, but that some nourishment was supplied to the extreme buds. Second, that the current should have been discontinued upon January 17th, when the degree of retarding had been secured.

I am convinced, however, that if this experiment could be carried on upon a sufficient number of trees, so that the effect of the different current intensities and periods of application could be observed, the exact time and strength could be readily ascertained which would retard the budding at any period which might be desired. As to the chemical effect of such electrical treatment, I cannot say but presume that the carbonates, nitrates and phosphates are changed into some other form of salts (probably peroxides) which do not contribute to plant nourishment, and, since it is a known fact that, for proper plant nourishment, the mechanical and chemical combinations must be exact, it is obvious that a slight change in the form of these salts will have its effect upon the development of the bud.

The simplicity of application and the cheapness with which an orchard could be so treated would commend the plan, even though the area to be so governed were large. Further, the quantity of current required even for large areas is evidently so small as to be available from a few dry batteries.

In arranging a large orchard for such budding control, it would require only that a galvanized wire (such as telephone wire) be run along or in the tree rows, with short connections made to silver tacks or pins driven into the trunks of the trees below the branch lines sufficiently deep to penetrate the center axis of the tree. The beginning or terminating end of this parallel circuit would connect to the negative side of this source of electric supply, while the positive side of this supply would be grounded in some suitable manner, as by a pipe or rod driven into the ground.

Since the potential employed is low there will be no need for insulation of the wire where it passes through the trees. Therefore the expense of installing and taking down, if it be found desirable to remove the wire, would be a minimum.

It is hoped that the suggestions here given may be followed out more conclusively than it is possible for the writer to do and it is with this end in view that the above experiment is described.

The above experiments have been carried out unofficially, since they are not within the scope of the irrigation investigations carried on under the Office of Experiment Stations, U. S. Department of Agriculture.

I would like to add, further, that it should not be understood that the application of electric current for the above purpose has an analogy to the high potential, high frequency application of electric energy in stimulating plant growth by overhead inductive effect as one is electro-chemical and the other electro-static and the effects are entirely dissimilar.

It should not be understood that the above preliminary experiments are conclusive or may be immediately utilized. It will require further experiment to determine the full value of this possible protection against premature budding. If further investigation proves the correctness of my conclusion the application should prove of inestimable value to the fruit industry.

P. E. FULLER,
Irrigation Engineer, U. S. D. A.

Riot Gun for Trench Fighting

To the Editor of the SCIENTIFIC AMERICAN

As an officer in the National Guard of my native state, I am naturally interested in what may be termed the military and preparedness features of your excellent periodical. Mr. Crossman's article on the bayonet and Mr. Hall's ideas in favor of the riot gun and the pistol against the bayonet are especially timely.

It has been a matter of constant wonder to me that the automatic or pump shot gun has not been used in defensive trench fighting as suggested by Mr. Hall. I have always thought that should I ever have a sector of trench to defend with a company of infantry or even a larger unit, I should most certainly prefer a six shooting pump gun with buckshot loads to the Springfield for "close-up" work, unless disadvantages which have not yet occurred to me should subsequently become obvious.

It is difficult to imagine an effective bayonet charge against infantry strongly intrenched and armed as I have described in addition to their usual shooting irons. The rifles could of course be laid aside with the bayonets fixed for emergency, but after the attacking force came past the hundred yard line and even to the very parapet of the trenches I believe the modified riot gun would have a better reach and prove far more effective than the bayonet, a crude and unwieldly weapon at best.

I do not attempt to deal with the complication in ammunition supply, the dual equipment the short effective range or the danger of changing weapons at the crucial stage of the action.

Probably these are the points which have weighed against the riot gun as a defensive military weapon. At any rate I should like very much for some authority to discuss the subject in your columns.

H. L. OPIE.

Staunton, Va.

Aiming a Rifle

To the Editor of the SCIENTIFIC AMERICAN

Under the above heading I notice in your paper of February 19th, that Mr. Edser agrees with Mr. Trotter that "one sees three front sights," "blurred hind sights," and other horrors.

Why do these gentlemen shoot under entirely unpractical conditions and then instruct us how to avoid seeing everything blurred?

Of course if a man shoots in a black "coal cellar" with a glimmer of light at the far end illuminating a small white card with a minute black dot on it, and tries to aim at this he sees everything indistinctly.

Worse, he ruins his eyesight irreparably, and does not learn to shoot for all his trouble.

The way to shoot is, first put a big ivory front sight in place of the black one used for target shooting.

Most real objects one shoots at are more or less dark, and the black front sight is difficult to see on the object, the white shows up at once.

Next have your hind sight put on the rifle at the distance from your eye that you can read print best.

When shooting do not try to focus a black bull's-eye, a black front sight and a black hind sight and half a dozen other things alternately while you hold on to your rifle like grim death.

Look at the object you want to hit. If it is moving judge how much allowance in front you must make, bring up your rifle to your shoulder swinging it with the movement of the object you want to hit and press the trigger as the butt touches your shoulder.

The bullet will go where you want it to without your noticing sights at all.

If you want to be a good rifle shot at game, or as a soldier, join the nearest Clay Pigeon Shooting Club and when you can break 90 per cent of the clays you can rest perfectly confident that you can hit a man every shot you fire if being charged by an enemy if you have a rifle in your hands instead of a shot gun.

If you practice in a "coal hole" rifle gallery at a stationary black bull's-eye with a black front sight and see "three front sights" and "blurred back sight" you are not learning to shoot but merely ruining your eyesight.

WALTER WINANS.

London, England.

The Canals of Mars

To the Editor of the SCIENTIFIC AMERICAN

A sketch of Mars was made here on the night of March 11 at 8 h. 40 m. with our 11 inch refractor, and the result was almost identical with the figure shown in your issue of March 11. The chief difference was that our large telescope showed a number of faint canals that were purposely omitted from the figure as confusing and unnecessary for the purpose for which it was designed. It was noted, however, that the two canals shown were appreciably fainter than they had been earlier in the year. They were, therefore, more difficult than previously in our 3-inch telescope, with which the following observations were made. Seeing 8 is practically perfect for a telescope of this size.

March 11. Thoth can be clearly seen, but is not easy. Syrtis major conspicuous. Snow cap fairly easy. Magnification 180. Seeing 8 to 7.

March 14. The canals can be faintly seen, especially Nilosyrtis, and the end of the Syrtis. Think magnification 240 is better than 180. Seeing 8.

March 15. Can glimpse Thoth and Nilosyrtis with magnification 180. Cannot see them with 120. Seeing 8.

As indicating the interest taken in such observations and predictions by your readers, whether they are professional or amateur astronomers, or simply the interested public, I should be greatly obliged to any of them who may have looked at the planet on the dates specified in the article if they would send me postal cards stating whether they succeeded or failed to see the canals. They should give also the diameter of the lens and the magnification marked on the eye-piece of their telescopes. The fact that they may have failed to see the canals is of quite as much interest as if they had succeeded, and should be reported with the other data.

WILLIAM H. PICKERING.

Harvard Astronomical Station, Mandeville, Jamaica, B. W. I.

"The Guácharo"

To the Editor of the SCIENTIFIC AMERICAN

Far from me be the wish to detract anything from the value and importance of new discoveries, whether in the field of fluvial exploration or ornithological research, but I am constrained to remark concerning this *newly* discovered bird of the tropics that in the interior of Colombia the "guácharo" has been well known for more than three centuries. It is a member of the family of *caprimulgus* or "goat sucker," of the group called *fisirostrus* from a peculiarity of their beak.

In the central portion of the Department of Tolima in Colombia there is a very considerable cave called Cueva de Tulini, in itself an object of much interest, which is a permanent habitat of this nocturnal bird. It builds its nest very artistically of gravel and sand, apparently cemented with its own saliva. Its food consists chiefly of beetles, moths and other night flying insects.

The tenancy of this cave by the guácharo is shared only by innumerable bats of several species. In some parts of the cave the floor is deeply covered with the excreta of these birds which makes an admirable fertilizer and is much employed by the nearby agriculturists for enriching their gardens and especially in the preparation of "eras," or beds for starting the seedlings of the tobacco plants.

Baron von Humboldt visited the Cave of Tulini early in the last century and speaks of it as a noteworthy natural curiosity and also describes the habits and peculiarities of the guácharo.

W. S. CRANE.

Wood Wastes—II

Results and Remedies

By J Gordon Dorrance, F E, State Board of Forestry, Maryland

Photographs by U S Forest Service

[This is the second instalment of a paper on wood waste by Mr Dorrance The first instalment appeared in the SCIENTIFIC AMERICAN, *of April 8th and dealt with the woods, the mill and the factory*—EDITOR.]

As the occurrence of waste has its inception in the woods, is resumed in the mill and practically concluded in the factory, so must measures for its reduction or elimination follow the same general course Now the remedying of present defects in the mill and in the factory is to a very great extent, a matter of mechanics Much is written and said nowadays of *efficiency* and it is becoming common knowledge that the man in business and especially big business as we know it who is satisfied to merely talk about efficiency had much better leave business while he may for if he does not possess himself and all that is his of methods of efficient management, the lack of it is sure in time to possess itself of him

The old time circular saws, in the days of their general use, were renowned for their great speed of cut, but they are now chiefly recognized for the thoroughness with which they waste the material which comes their way Yet mills with such equipment do still exist, are in operation and may occasionally be found in the mountainous parts of the South either as stationary mills or as the more common portable mills which use saws of no other kind moving about the country from place to place and cutting it clean as they go Their waste is often more than half Very recently there was a circular saw mill in operation quite close to New York city but their use now is not growing, and is relatively limited, so that it is seldom expedient or possible to replace them with some more modern make—since they are usually to be found running where the exhaustion of the local cut is already in sight.

Modern Methods of Milling

Elsewhere, in the great forests of the West, in the still larger pineries of the Gulf States to the South, the band mill, fast and efficient as the circular never was, has taken its place The band saw is a very practical remedy for waste The old mills usually wasted as much as they manufactured, frequently more There are some mills still running, which have one foot of board to show for three of log But the band saw is one of narrow kerf and as it flashes through one log after another there is the minimum of loss It is run as it must be by a sawyer who is master of his trade, and the rough boards are cut from the log with the greatest precision and care Their further manufacture frequently leaves something to be desired, for even lengths and widths are still the rule in many plants and the difference is often much Odd sizes have found their way into some Associations' grading rules, but to a very slight extent into the hands of the trade However, there is generally a more careful use of the edgers and resaws, with a smaller number of the old gangsaws employed about the mill Changes of rulers have helped to utilize more of the defective stuff although there is still room for a better utilization of the shorter lengths of lumber

In an occasional plant is found a new kind of resaw—one exclusively for slabs—which turns 'barky' material of all sizes into lumber of merchantable dimensions They are capable of saving and sawing several thousand feet of lumber in a day and there should be more of them in use Sawdust is still blown out to great piles from most mills and there are comparatively few where it is sold That it may be otherwise disposed of than blown away or burned has been proved to the satisfaction of one firm at least which receives about $30 a car for whatever they choose to market in this way As the cars are placed on a convenient siding, and the end of a blower inserted at the top of the door, the process of loading entails little labor, and this disposal is nearly all profit The sawdust is taken by several ice companies in a nearby city, and some also is used by packing houses and stables There are other general uses which pay as well, and in some sections alcohol is being made of it. In one or two places such material is even pressed into bricks to be used as a cheap and readily handled fuel, after the fashion of the briquettes of Europe, also a product of successful waste disposal

As to the slab wood the cuttings and trimmings, there are additional fields. The distillation of certain softwoods for turpentine is possible, chestnut furnishes material for tannic acid, hardwood distillation and other special processes produce charcoal, grain and wood alcohol gray brown and iron acetates—nearly all articles for which there now exists a greatly inflated demand Trade in them should be captured while it may be easily secured Even in hardwood ashes there are possibilities for further utilization through the great need of potash The softwoods in general—spruce, hemlock balsam pine—as well as such of the harder woods as poplar cottonwood, and soft maple, are available for pulp making, and have been so used quite profitably in certain cases.

Ten years' accumulation of silt behind a dam, the wash of a deforested watershed, which caused a temporary shut-down of a power plant

The forested watershed

As a protector and regulator of water supply the forest fulfills an important office

New Ways of Factory Waste Disposal

At the factory such improvements and innovations in methods and operation should be continued. Better designing by the draughting room is an aid to complete utilization, while such modern equipment as the machines which perfectly dovetail and glue waste pieces as narrow as one inch to a single strong, usable block of wood, are an instance of closer utilization proved successful. The right sequence of operation is important in wood working and manufacturing in the right order is nearly as essential as manufacturing in the right way If the residue from turning out the firm's principal products may not advantageously be converted into some by product in the plant itself, there are other uses outside which are still feasible.

The United States Forest Service some time since began the experiment—for it was altogether new and untried then—of a Wood Waste Exchange They first ascertained the kinds amounts, and sizes of woods which a large number of wood working firms were selling as cheap firewood, or using themselves as such, and then prepared a list of "Opportunities to Buy and Sell Wood Waste" At present the names of over two hundred factories and mills appear upon their monthly statement, and it is proving of actual service There is no charge for the Government's coöperation in this, and much has already been accomplished in a practical way For instance they cite the case of a large firm in New York city which manufactured novelties, using for the purpose small, half finished pieces of dogwood. Through the Forest Service's list they were enabled to secure the rejected and principally disused material of a manufacturer in another line, paying for it substantially more than it had brought as kindling, at the same time much less than the buyers had always paid for large-sized lumber which was only cut up to small pieces. Similarly a maker of wooden backed brushes began to purchase material of the right kind, size, and price from the waste pile of a school desk factory These cases are representative of the work that the Forest Service is doing toward the practical discouragement of useless waste It is a step in the right direction.

Several States are carrying out similar plans, and in some of them, for instance Maryland it promises to be equally successfully in a more restricted way Valuable as is this outside aid, it cannot accomplish everything, and the manufacturers themselves may find in the factories making novelties, tool handles, gunstocks, brushes, picture frames, umbrella sticks, and parquetry work, perhaps in their own city, a market for their wares. Modern, intelligently operated machines, efficient direction, and the coöperation of employees are the real essentials to the better use of mill and factory waste.

Forest Uses as They Should Be Here and as They Are Elsewhere

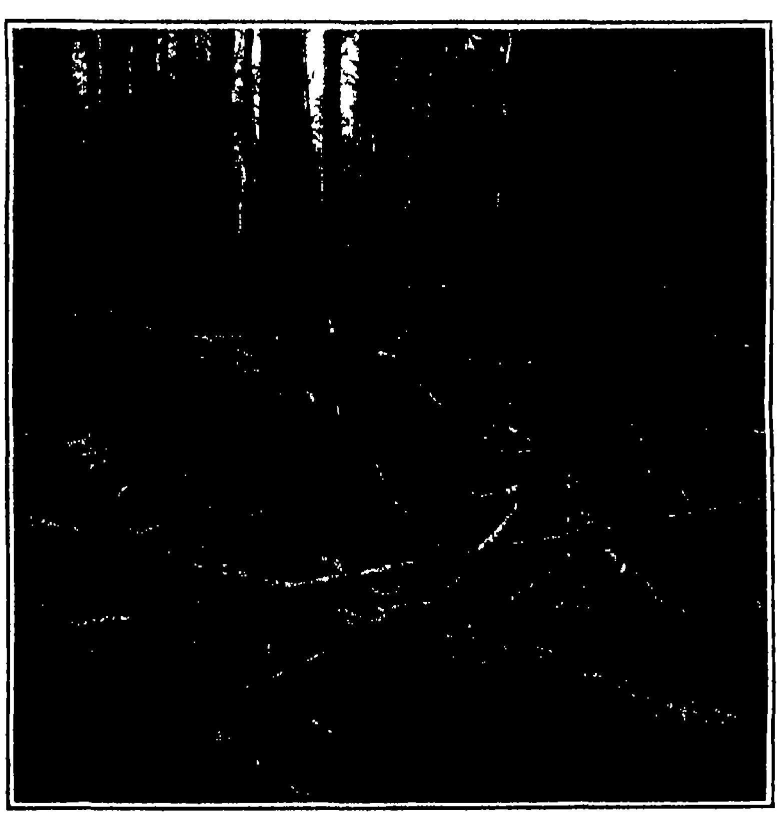
Since but 66 per cent of the tree finds its way to the mill, becoming there 44 per cent in boards, 35 per cent in the final factory product, the importance of a right beginning is clear, a beginning that must be made in the forest itself

Many suggestions for the marketing of mill waste are applicable also to the woods operation. Cutting to a reasonable diameter limit, careful work that uses to the full the cut trees, and protects sufficiently those that are uncut, the leaving of a few seed trees per acre to regenerate the stand with other trees of value; burning or scattering brush and refuse to reduce the subsequent fire hazard, close use of still sound construction mate-

rial, and of the logs which have fallen from logging cars or sunken in river drives, all must be consistently carried out to reach the end desired. It is not an easy matter to arrange, and the decision must rest largely with the ultimate users—the public.

Reforestation in Europe is one of the oldest investments for communities and individuals to make

In the cities of Germany, on a Sunday, you will see the poorer citizens picking up small twigs and fragments of wood in the parks and under the trees, later carrying them away home in baskets or little carts Twigs used there, logs discarded here, and still we have so much, apparently that we do not take time to appreciate or really feel the need of it. Perhaps we may be generally lacking in good management and efficiency, and really do not know how to do better Probably it is a little of both Plenty means low prices, and low prices a low regard Lumbermen have been heard to say, when listening to complaints about their prices "My dear sir, the prices are not half high enough" Perhaps, viewed in a broader way, apart from the varying standpoints of producer or consumer, he is right. Certain it is that abroad corresponding values maintain so much higher a level, that wood waste there is an extravagance which economy will not permit, nor public sentiment allow



A "burn"—a heavy stand of red spruce and balsam reduced to blackened timbers which will be valueless unless removed immediately

It is largely a matter of tradition and education. The people there are educated to a logging which takes the whole tree to a foot or more below the level of the ground, leaving at the end of the operation clear logs, no stumps, stacked cord wood, and bundles of faggots They are familiar with close use in the factory and home, and preservative methods which lengthen the life in use of such of the material as may be used outside Those methods have gone on a long time, and so have ours, and both are hard to change

Original Forests and the Forest Investment

Prevalent methods here have materially changed the area and composition of the original forests The present area is not much over half that of the first woodland, and the make-up of what remains has been noticeably altered and reduced. Forests in the North and East have been wiped out in many cases, or given way to scattered woodlots, in the South are eroded mountain slopes and the deforested watersheds of great streams. You hear reforestation spoken of and to date about one and one quarter million acres have been replanted to forest trees. About one hundred municipal forests have been established, and may in time become as generally accepted and desired as in the cities of France, Switzerland and Germany Some of the "communal" forests in Heidelberg are making as good net returns as $10 to $15 per acre per annum, and it is possible on such investments here to realize fully half as much, exclusive of the interest at 6 per cent on labor, trees, land and taxes.

Our system of taxation, on improvements, has worked such injury in the past that in Connecticut Michigan, New York, Pennsylvania and Vermont equable laws have finally been enacted which base their tax on forest plantings upon the actual value of the final yield, or income. Such protection, with the forest planting stock which 14 States in over 30 nurseries are distributing at cost to landowners, are strong incentives to this constructive step It may be added that the Federal Income Tax recognizes forest interests so far as to exempt from the final tax all costs of planting, protecting and growing the crop of timber The forest investment, however, by the very nature of its long life and relatively high cost must, to be most effective, be one made by National, State, or Local Governments. Some of these have made a beginning, which public backing will substantially increase. It is claimed by the Conservation Commission that lands fit only for reforestation and as such imperatively in need of it cover an area larger than the States of Pennsylvania, Ohio and West Virginia

Forest Fires: Cause and Prevention

Of equal importance with the reclamation of sterile lands which forest wastes have made possible is the capable protection of the areas still in forest. Such protection is now extended over only about one third of the total timbered area held privately, though the Forest Service, on its holdings, and a few States as well, are doing as much as limited appropriations will allow In one important Middle Atlantic State not a cent has ever been expressly appropriated for the protection of wood land which constitutes more than one third its total area The status and conduct of a State's affairs should not be so radically different from the incorporated town or city which must at all times safeguard property within its borders

Through Section 2 of the Weeks Law of 1911 the U S Department of Agriculture and the Forestry Divisions of certain States are lately coöperating financially to prevent loss by forest fires on the watersheds of navigable streams The same law has made possible the purchase to date of 1 317 000 acres of mountain forest in the East, purchases which together with those farthest West, make a nucleus of timbered lands where forest wastes at least will not be tolerated, and are already being proved unnecessary The Post Office Department is also assisting through its rural carriers in making prompt reports of forest fires It is estimated that more than one half of the occurring forest fires are due purely to inexcusable carelessness, and joint action upon the part of the public should reenforce the efforts made officially It is incumbent upon the public to exercise a certain amount of discretion in the care of the forests as in the uses of wood.

New Ways of Using Wood Waste

Encouraging signs however, are now and then appearing A New England paper manufacturer has developed a by product from his pulp wood waste which is said to be an acceptable substitute for lard other manufacturers are making gun stocks from small pieces of walnut left from the production of veneers securing a product in excellent demand, and in varied lines first attempts at a timely and better utilization are being made One of the largest railroad systems in the United States has tried the experiment of reclaiming instead of burning its worn-out rolling stock Old freight cars have recently been taken apart to see what of value was really in them, and it is said now that the experiment will be continued as long as their supply of old cars lasts. The official in charge of the work summed it up by saying that "burning an old car means the actual destruction of $20 worth of timber, for the returns from the salvage have demonstrated that it is as valuable as that to a railroad. Machinery for resawing lumber makes it possible to work over old piling, bridge timbers and car material

Among the great lumber countries of the world there are but three which may increase exports without a decrease in forest capital—Russia Finland and Sweden Since the deficit grows in Western Europe, which for generations has not been self supporting where timber is concerned it does not constitute a reliable source of supply should our own be exhausted. It is probable that requirements for agricultural lands will soon reduce still further our total wooded area, leaving perhaps 400,000,000 acres for forest culture. Under present methods it is not enough nor would be were it twice that size With less waste better management, and more intelligent use throughout, 400,000,000 acres might prove ample.

The story of lumbering and wood using in the past has been brief and to the point—prodigal use and over production, low prices for high grades and loss of the rest. Illy-devised and poorly applied taxation has discouraged alike the holding of old timber and the growing of new Great waste has resulted of timber of wood of land—of resources not readily restorable Remedies have been pointed out a few have followed them But this is no subject for individual undertaking or single handed effort The public must act in unison with the States and Governments which represent them Efficiency is the keynote of progress in the development of the American forest and its products

Reclamation through forest planting - a stand of Scotch pine four years from planting

War Game—VI

The Decisive Attack

By Guido von Horvath

THE objective, the point selected for the decisive attack, should be struck unexpectedly and with the greatest possible force. The tactical decision is brought about in several ways. The envelopment of the enemy's flank is the one most commonly employed, and is the one which ordinarily gives the greatest promise of success.

The meaning of envelopment is clear and simple. The enemy is held to his line, or in his position by a part of the offensive force while other parts attack one or both of his flanks. The result of such an attack, when successfully carried out is a superior, converging fire more or less enfilading the enemy's position. Naturally, the moral effect of a successful enveloping attack is very great. If properly prepared, and if the flank against which the main assault is directed is taken by surprise, the attack will result in the defeat of the enveloped enemy.

It is well to remember in studying the tactics of the attack, that in combat an action always should bring a counter action. Except in the case of a surprise there is always some action which will defeat the plans of the enemy. The form which the counter action, the counter attack, will take, as well as its probable success will depend in large measure upon the personality of the commander.

It would seem almost absurd to assume the possibility of a complete surprise. The service of security, with its thorough reconnaissance, should make a surprise extremely unusual. At least, it would seem so on our map. History tells a different story, and there are good reasons for all of these instances of surprise attacks. In our case the attack of the Red cavalry, as related in the previous Game will be clear after considering the shelter of the Lebanon Forest, which made the surprise possible.

It may be assumed as true that, while the vigilance of the enemy diminishes the chance of surprise, it does not eliminate it altogether. For this reason in the War Game, as well as in actual warfare, the commander must strive to surprise the enemy. The envelopment of one of the flanks or in very rare cases the envelopment of both flanks, is one of the surest means of forcing a decision. But it must be carried out, in order to be successful in coöperation with the fire action of the frontal group, and this fire action must be worked gradually to such a serious menace that the attention of the enemy commander is diverted from the dangers threatening his flanks.

Another form which the decisive attack may take is the penetration, the piercing of the enemy's line. This can be accomplished by careful and thorough fire preparation, and the timely and well selected massing of reserves at the point where it is planned that the enemy line should be penetrated, then separated and rolled up.

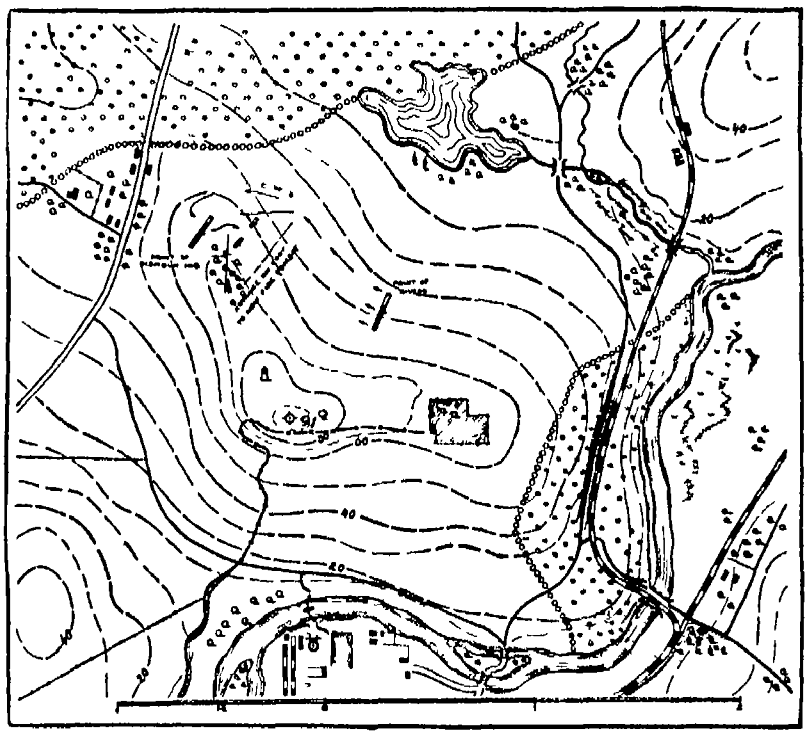
Note: The Turning Movement, another form of decisive action we shall not consider here as it involves too great forces to be handled successfully in our War Games.

Aside from the principles involved in carrying out the foregoing methods of forcing a decision, we must remember a few of the controlling principles which are necessarily a part of these methods and without which we cannot hope for a favorable decision.

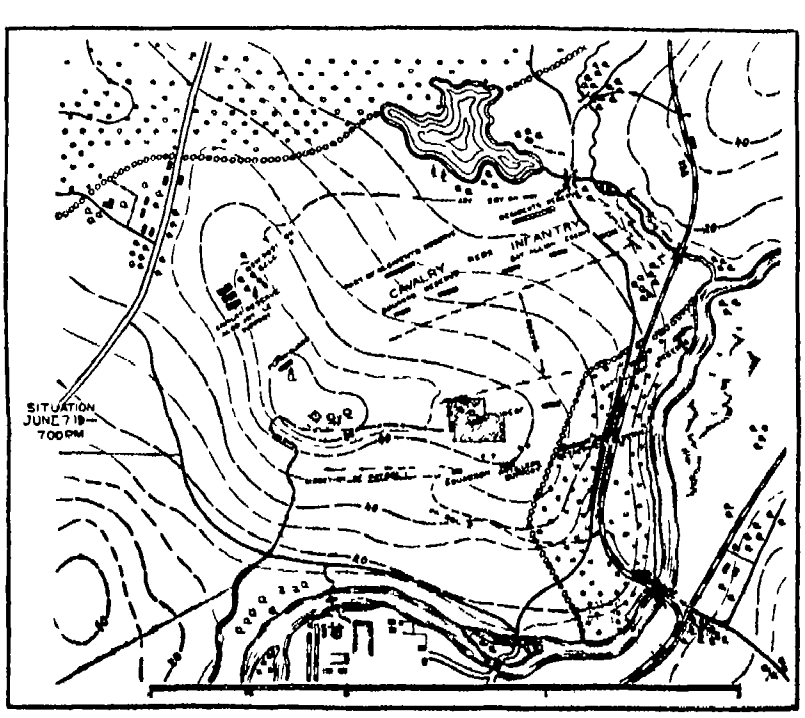
First it must be understood that in the War Game, as well as on the field of action, the rôles of the fighting forces are not distinct and clearly defined, nor can they be so defined. Second, that decisive success in combat can be gained only by a vigorous offensive. From this, it follows that, with the exception of infrequent and peculiar situations, every commander who offers battle with the expectation of gaining the victory, must, sooner or later, assume the offensive. Often the situation is such that the offensive may turn or be turned into the defensive, just as we have shown in War Game V, where the Blues were forced to take the defensive.

Of course, in the War Game the skill of the commander and of his subordinates is the only decisive factor. The War Game is a battle of brains. On the field of action on the other hand, organization, training and, above all, a firm determination in all ranks to conquer at all costs, are factors which must be added to the skill of the commander.

Both in the War Game and in actual warfare, half-hearted measures can never bring victory, and the lack of determination is the source of defeat. Hesitation and inactivity are far more harmful than action based upon faulty plans. The latter may develop into success—inactivity never will. The fruit of hesitation is inevitably an advantage to the enemy, he will surely utilize the time gained to force his own will upon the hesitating commander. *All of these considerations lead up to the one cardinal principle Action. Make your decision, issue the orders which will carry out your decision, and go ahead.*



Answer to Question 2 in War Game 5



The situation on June 7th, 19—, at 7 P. M. Answer to Question 3 in War Game 5

Once these principles are understood, we can consider the next important factor in gaining the decision. This is the well directed, accurate and overwhelming fire action of the combined arms, to be crowned, at its climax, with the assault of the Infantry.

In order to give a picture of these fundamental principles, we shall now go back to the problem of the Reds and the Blues, just in the situation where we left them at the end of War Game V.

The Attack: Enveloping One Flank of the Enemy

Night has come to the battlefield of our problem. With the darkness, the fire of the forces facing one another has slowly diminished. Both commanders have realized that the day's struggles have sapped the strength of the firing lines, and have weakened the spirit of the reserves. The darkness of a moonless night must be used to give some rest, an opportunity to feed the men, to refill emptied cartridge belts and to care for the wounded.

In such close proximity to the enemy, the firing line must remain where it was at dusk. If the position is to be held, the darkness must be utilized to throw up entrenchments, if trenches have already been constructed they must be consolidated and strengthened.

The rest under arms on the battlefield will not be of a peaceful character. At the slightest provocation, bullets will whistle back and forth. If there are searchlights on the field, they will sweep across from time to time, to vanish again in the darkness. The vigilance is tense and high pitched, but it is an organized vigilance nevertheless. Those men not on duty will, even under this tremendous nervous strain, fall asleep from sheer exhaustion.

Under such trying circumstances, the night will pass with slowly dragging hours.

Somewhere on Lookout Hill, behind the lines, possibly in Argus farmhouse if not destroyed by the enemy's artillery fire, perhaps on the edge of Pine Forest, by the dim light of his camp lantern, Colonel K., the Blue commander, is making his plans for the morrow's action.

It is highly important for the student who is following these Games to try to visualize the action, just as though he were actually on the field. This is the reason why, instead of the usual formal statements which tell the situation, and orders of a purely mechanical character, the writer is trying to lead the reader into the heart of the real action.

In the headquarters of the Blues, Colonel K. and his adjutant are studying the General Staff map of the country. The Colonel holds several written reports and orders in his hand while the adjutant is carefully measuring distances on the map. Then he glances over these documents again.

They read as follows:

(Concluded on page 455)

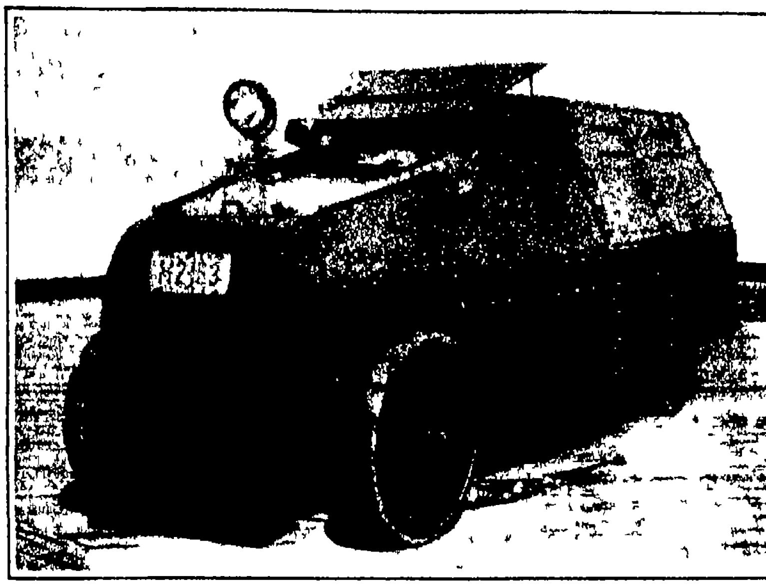
Armored Car Battery for the United States

UTILIZING the experience gained in the European war, there has just been formed in New York City an armored car battery, which is to be a special organization under the direction of the New York National Guard.

The new organization has been rendered possible by the presentation of 40 armored cars to the state by several men prominent in finance and industry, who have taken a leading part in the preparedness campaign. The contributors are E. H. Gary, H. C. Frick, R. M. Thompson, D. Olcott, G. N. Wallace and H. G. Montgomery.

The first unit of the organization to be completed is a heavy armored car, which is shown in the accompanying illustration. The battery comprises battle cars fitted with rapid fire guns, anti aircraft cars, repair cars, tank cars, motorcycles and auxiliary equipment. The entire organization is modeled closely on existing batteries in the European war, combined with the experience gained in the National Guard maneuvers of last fall in the Plattsburg camp.

Although so far only 10 cars have been placed in actual service, it is the intention to add the others as soon as sufficient men can be enlisted for their operation. Seventy five motorcycles are now ready for use in connection with the cars, the whole force being under the command of Capt. Harry G. Montgomery, who has been the most active worker in connection with the organization of this battery.



The armored motor truck which forms the initial unit of the recently formed armored car battery of the United States

Simulating the Conditions of an Actual Fire in Testing a Record Safe

AS a striking demonstration of fireproof furniture, a light, movable, steel safe cabinet has been constructed that will preserve papers, currency and valuables of all kinds under conditions equal to those of the most devastating fires. Recently this cabinet was subjected to a very rigorous test whose very severity makes it of more than passing interest.

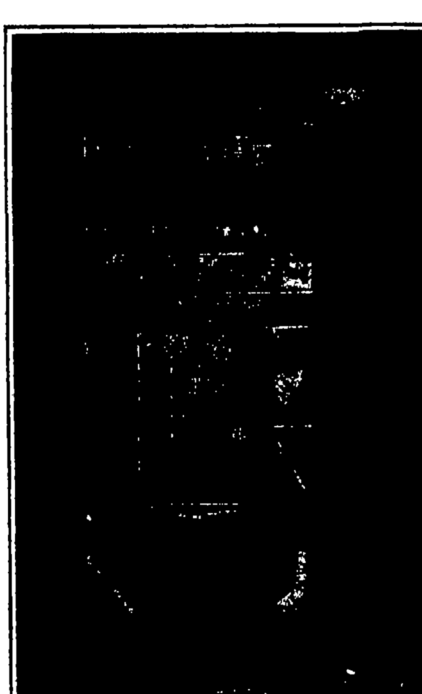
Into the steel cabinet were put filing devices partially filled with records, papers, books and memoranda, and a considerable amount of currency. In the first of the accompanying views is shown the appearance of the cabinet interior before the test. The doors were then closed and locked and the steel cabinet placed in a specially built brick retort furnace, the dimensions of which allowed more than a foot of space on all sides and above the steel cabinet.

Through the door of the retort there were introduced twenty 3-inch natural gas burners, arranged so as to distribute the heat evenly throughout. Six thermo-couples—four inside the cabinet and two outside—were installed to record the temperature. Readings were to be taken from a pyrometer galvanometer graduated in Fahrenheit degrees. The door of the retort was closed and the gas ignited with an electric spark. Through observation holes arranged in the walls of the furnace the steel cabinet was seen to be surrounded by a solid wall of fire averaging nine inches in width. Temperature readings were then taken every minute for the first 20 minutes, after that, every five minutes for 25 minutes. At the end of this time, 45 minutes in all pyrometer readings showed the temperature inside the retort to be 1 820 degrees. The four thermo-couples inside the cabinet indicated a temperature of only 220 degrees.

The gas was then turned off and the cabinet removed, red hot, and placed at once on an elevator. It was hoisted to the top of a 80-foot tower, from which it was thrown down, whirling the safe cabinet with sufficient force to give it at least one complete turn during the fall. The center view in the accompanying illustrations shows the safe dropping from the tower. As soon as it struck the ground a ton of bricks was hurled on top of it. The bricks completely covered the cabinet, and for test purposes equaled the falling of walls containing many tons of bricks. The weight of the bricks in a test of this kind is considered negligible, the first impact being the damaging agent.

The cabinet was then placed in the retort again and the heat turned on as before. For a period of 60 minutes, during which time the pyrometer indicated a heat of 1 880 outside the cabinet and an average of 244 degrees inside, the ordeal of fire was continued. At the end of that time the cabinet was removed and allowed to cool for a period of three hours. It is well to add here that during the final hour in the furnace the highest temperature recorded inside the steel cabinet was 262 degrees, which is about 50 degrees lower than the danger point for combustible materials such as paper. The cabinet was subjected to a furnace heat for a total of 116 minutes.

In the third and last view appears the interior of the cabinet when opened after it had been allowed to cool. The contents were found to be disarranged, to be sure but unscathed. The records found in the filing devices were not even discolored and the paper money was not scorched. Nothing that was placed inside the cabinet for the test was destroyed or damaged.



Interior of the steel cabinet prior to the test, showing its contents.

Dropping the cabinet to the ground 80 feet below

Interior of the cabinet after the fire-resisting test

Phases of the test to which a portable, fireproof, steel-cabinet safe was recently subjected

Electricity as a Silent Waiter in Restaurants

NO longer will the shouting of orders to the kitchen hands be characteristic of small restaurants in the future, at least not if a recently invented system of ordering is installed.

The new hotel and restaurant indicator is primarily intended for restaurants of the quick lunch type and in hotels and clubs. The apparatus comprises a cabinet in which are contained as many electrically operated number dial devices as are required by the menu of the institution where it is used, acting as the indicator in the kitchen, and one or more sending stations in the dining room in the form of wall counter or post plates mounting a plurality of push buttons each of which is labeled with the dish it represents.

The cabinet containing the indicator units is placed in the kitchen of the establishment where it is installed. It can be made in any size for accommodating 16 to 100 units. When the waiters push the buttons of any of the sending stations the corresponding indicators of the cabinet are operated signifying the food desired. The numbers in the kitchen cabinet advance one at a time as the buttons in the restaurant are depressed so that any number of orders for the same dish can be signalled from the dining room without danger of confusion or error. The chef checks off each article sent out from the kitchen by pushing a button at each unit desired causing the numbers to diminish one step at each push of the button. During the time any unit is "alive" or off zero a small incandescent lamp remains lighted and when no orders are registered the lamp is out. Thus at a glance the kitchen hands are aware of the issuance of an order and the number of orders to be filled for any particular dish is constantly indicated. The push buttons at the sending stations and the indicators of the cabinet in the kitchen are provided with removable labels of white celluloid so that the signalling system can be altered to meet changes in the menu.

The current required to operate the hotel and restaurant indicator obviously varies with the size of the apparatus, but it is said to be equivalent to that required by an 8 to a 32 candle power lamp. The cost of the installation also varies with the size and the number of push button stations wanted also the kind of electric current available. The wiring is run in steel conduit to make it water and moisture-proof.

Future Gasoline Supply from Shale

IT is estimated by the United States Geological Survey that in Colorado alone there is sufficient shale in beds 3 feet or more thick to yield 20 000 000 000 barrels of crude oil from which at least 2,000,000 000 barrels of gasoline may be extracted by ordinary refining processes.

Little attention has been paid to this shale because the quantity of petroleum produced from wells in the United States has been sufficient to satisfy all demands but for more than 50 years the oil shale industry of Scotland has been a very important one. In a recent year more than 8 000 men were employed in the industry in that country yet the average yield of oil per ton of shale was much less than that which appears possible from the shale of Colorado and Utah.

The area that has been studied by the Geological Survey comprises northwestern Colorado northeastern Utah and southwestern Wyoming. The shale found there contains materials which when heated may be converted into crude oil gas and ammonia. Sooner or later this great source of supply will be utilized to supplement the decreasing production from the regular oil fields of this country.

When refined by ordinary methods the shale oil yields an average of about 10 per cent gasoline 35 per cent kerosene, and a large amount of paraffin.

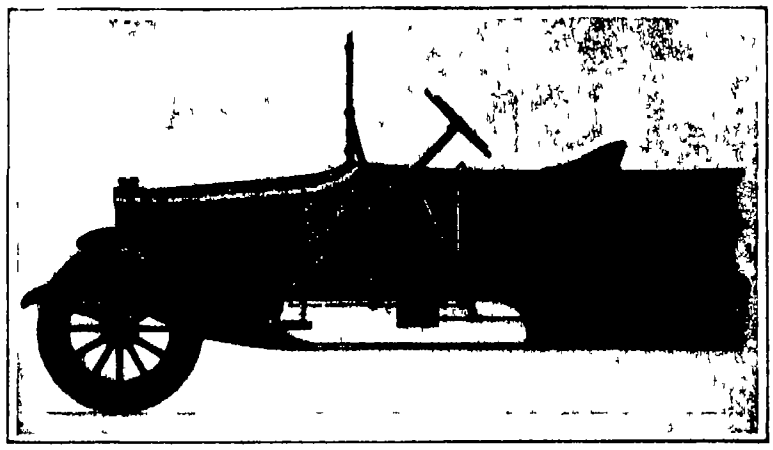
Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Auxiliary System of Control for Automobiles

A NEW YORK inventor has recently brought out a device whereby in cases of emergency the occupants in the tonneau of an automobile can bring the car to a stop by depressing push buttons which shut off the engine and apply the brakes. It is especially in instances when the chauffeur fails in his duties or is suddenly incapacitated that the invention is most valuable.

Briefly the device serves to apply the brakes and control the power of the car on which it is installed by means of a spring held under compression which is electrically released. The device weighs but 15 pounds and can be mounted in any car without interfering with the existing equipment. One novel feature of the control system is that while the occupants of the tonneau can apply the brakes and bring the car to a halt in time of emergency, provision is made to prevent them from interfering with the control of the vehicle at all times when the chauffeur is properly driving the car. Furthermore, in an emergency the chauffeur can apply the brakes by means of the device by depressing a push button conveniently located on the steering wheel.



New invention which enables the passengers on the rear seat to bring the car to a stop by depressing a push button

Veneer Trimming Made Simple by Use of Electric Motor

ON veneer woodwork there are usually edges to be removed after the gluing process is completed. It has been customary to do this work with a draw shave or rasp in the past but since the careless use of either of these tools renders the work liable to damage great skill is a necessary essential in its successful undertaking.

A small electric motor, which drives a diminutive circular saw at high speed has solved the problem of trimming veneer both quickly and safely even by unexperienced hands. Its saw can be adjusted to trim the veneer flush with the surface of the board to which it is applied or to any height desired by the simple turning of a screw. To operate the tool the workman simply pushes it along the edge of the work in the same manner as a flat iron is run over the surface of an ironing board. The saw extending just enough on one side to cut through the delicate wood, removes the edge rapidly without splitting it and without becoming clogged with dried glue. All the edges of the saw are protected except the one which is actually working, so that there is very little danger of injuring the hands through accidental contact with it.

Current for the veneer trimmer can be supplied from any lamp socket, and a connecting cord of sufficient length enables the tool to be used with considerable latitude.

Boy trimming veneer with the skill of a trained workman, by means of an electric trimmer

Newly invented oven for the curing of meat in the household, which is being largely employed in Germany

Simplifying the Teaching of Mathematics

THERE has been invented by Miss Albertina Beckmann assistant principal of the Jackson School of Cincinnati, Ohio a simple device which enables students to learn multiplication and division and subtraction and addition tables in the minimum of time. She has been granted a patent on her invention.

Briefly the invention consists of a board on which are printed rows of figures from 0 to 144. The rows are separated by grooves. The method of using the device is simple. For instance, if it is desired to learn what 6 times 4 is, all that is necessary is to locate the figure 6 at the top of the board, and then figure 4 at the side, then a ruler is placed in the groove nearest 6, as shown in the accompanying illustration and another ruler in the groove nearest 4. In the corner made by the two rulers the answer is found, in this instance 24.

If it is desired to divide 24 by 6, one ruler is placed between 6 and 24 and another ruler is placed in the groove that runs at right angles with 24, and the answer, 4, appears immediately at the outside end of the second ruler.

The device lends itself equally well to simple problems in addition. If one desires to learn what 6 plus 18 is, it is necessary to first hunt up the 6 column and underneath the 18 will be found the answer, 24. If it is desired to subtract 6 from 24, the reverse operation of the foregoing-described method is resorted to.

A simple mathematical device that greatly simplifies the teaching of elementary arithmetic, and its inventor

Smoke Oven for Curing Meat at Home

IN the present times of economic difficulty in many countries of Europe, many housewives are confronted with the problem of accumulating such stores of preserved meat as possible for that article of food is scarce indeed and there is no telling what the future may bring. A new household device has just been invented, however, which admirably serves to this end. It is a special oven for curing meat at home.

The new apparatus consists of a lacquered cylinder which is provided with an interior dividing wall, separating both halves of the cylinder. One portion is designed to hold the meat to be smoked, while the other is for the passage of the smoke. Underneath is a smaller cylinder which serves to admit the smoke. This is so constructed that the smoke must first pass through the transmission compartment and enter the smoking compartment from above, in order to return finally to the fireplace. That an even distribution of the smoke may be achieved, there is a perforated plate above the smoking compartment in the large cylinder. This also serves to prevent the entrance of particles of soot and dirt. Two rings are provided on which to support the meat.

The home meat curing oven may be installed in the cavity of any fireplace, without much preliminary preparation. The smoke may be furnished by dry saw dust, tanbark, or by any suitable material which burns with considerable smoke.

Contemplated Mangrove-Bark Trade in Brazil

THE percentage of tanniferous extract usually obtainable from the Brazilian mangrove seems to be about 36 per cent from the wood, and 24 per cent or less from the leaves. No apparent use appears to be made of this important natural source in that country. The chief difficulty is reported to be a legal one, many of the municipalities of Brazil have the fear that if promiscuous cutting of mangrove swamps were permitted the sea would make inroads upon the denuded coastal regions and, besides, that dangers of fever would be present after the deforestation.

Another very great, but perhaps not insuperable, difficulty lies in the fact that by law a broad strip of the Brazilian shore, throughout the coast, is reserved to the government as a "maritime zone" for the purpose of national defense, and that this would include practically the entire habitat of the Brazilian mangrove. It would probably be possible, however, to obtain concession from the Brazilian government to work certain defined coastal sections.

It is reported that several parties have already signified their readiness to furnish mangrove bark, both leaf and wood. The latter is valuable for use as construction material, especially piles and railroad ties, and has, as such, already attracted attention in France.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

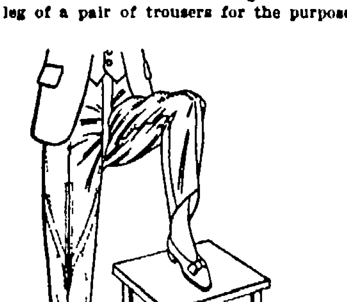
DETACHABLE HEEL.—A. BECKELMAN, 1473 Hoe Ave., Bronx, New York, N. Y. This invention relates to heels for shoes and particularly to what is known as a detachable heel and has for an object the provision of an arrangement of securing means whereby the heel may be quickly and easily applied and removed and when applied will be held rigidly in place.

ICE CREEPER.—P. J. PINTO, 233 E. 151st St., Bronx, New York, N. Y. This invention has reference to an improved ice creeper or non-slipping device for use upon the foot and has for an object the provision of an improved structure which may be quickly and easily applied and removed.

HAT CONFORMATOR.—A. C. LARSON and C. J. OLOFSON. Address the former 606-608 Seventh Ave., Rockford, Ill. In this instance the invention is an improvement in hat conformators, and has particular reference to a device which may be automatically fitted to the head and the hat subsequently mounted thereon and shaped to conform to the head of the person to be fitted.

FOLDING UMBRELLA.—S. C. BURNHAM, 233 W. Everett St., Dixon, Ill. The more specific object of the invention is the provision of a novel arrangement of bows and braces whereby the umbrella can be folded into a very small space, the rod of the umbrella being made in telescoping or detachable sections so that when the umbrella is not in use the total length will be reduced to a minimum.

TROUSERS KNEE LIFTING DEVICE.—S. ABRAMSON, 251 Bleecker St., New York, N. Y. This invention relates to a lifting device for each leg of a pair of trousers for the purpose



TROUSERS KNEE LIFTING DEVICE

of automatically lifting the lower portions of the legs when the knees are bent, as in sitting down, ascending steps, stooping, and the like, whereby the objectionable bagging of the trousers legs at the knees is positively prevented and movement of the legs is unimpeded.

BRACELET.—B. R. JOLLY, 128 Fayetteville St., Raleigh, N. C. This invention relates particularly to a bracelet formed from links in such a manner that the links will give or spread. An object is to provide a bracelet formed of links, having overlapping parts and a spring for resiliently holding the parts in a predetermined position while allowing a stretching or sliding movement of the parts.

HAT DISPLAY RACK.—M. A. WILLIAMS, Thurber, Tex. This invention relates to hat display racks forming a part of the accoutrements of a haberdashery for the supporting or display of hats in such a manner as to permit a full line of hats to be displayed as well as to economize space and render more convenient the keeping of the hats in stock.

HAT.—B. WERTHEIMER. Address F. P. EISEMANN, 41 Park Row, New York, N. Y. This invention provides improvements in ladies hats whereby a proper fitting of the hat is insured and the hair of the wearer is utilized to hold the hat in place on the wearer's head. To accomplish this use is made of a head band or bandeau extending within the crown and having one side bent outwardly toward the adjacent portion of the crown and at an angle thereto.

Electrical Devices

INSULATOR.—W. G. CARR. Address W. A. Snoop, 2202 Oak St., Trenton, Mo. The invention relates to insulators to be formed of glass or other non-conducting material and having means for securing the same on a pin or other support and for engaging conductor wires. It relates more particularly to an insulator in which pairs of retaining lugs are provided on the insulator for engaging the wires.

SUPPORT FOR ELECTRIC WIRES.—R. B. DURAN, Calle Gracia Carrillo, Torreon, Coah., Mexico. This invention provides a support for electric wires which makes the use of an auxiliary supporting cable unnecessary, while at the same time, doing away with all danger of broken or fallen electric wires. The invention also prevents the wearing of the wire sections at their supports.

TERMINAL CONNECTOR FOR STORAGE BATTERIES.—P. M. MARKO, 1191 Bedford Ave., Brooklyn, New York, N. Y. In this case the invention has reference to storage batteries for starting, lighting, and other purposes and has to deal more particularly with the terminal connectors, whereby the cables or wires are connected with the terminal posts of the battery.

LIGHTNING PROTECTING SYSTEM FOR OIL TANKS.—C. H. GUNTHORPE, Beaumont, Tex. An object here is to provide a system by means of which there will be no likelihood nor danger of a spark occurring within any oil tank even should it be struck by lightning. A further object is to provide a system wherein the various plates which go to make up an oil tank are brought into good electrical condition, one with the other and properly grounded.

Of Interest to Farmers

HEN'S NEST DEVICE.—H. W. KEMBLE, Setauket, N. Y. This improvement relates to means for breaking up sitting hens and the main object thereof is to provide means within a nest which will prevent a hen from generating the heat required for sitting and thus causes her to give up her desire to sit.

INSECT DESTROYER.—C. L. KING and S. A. MCKIE, R. F. D. No. 2, Brownwood, Tex. This improvement provides an apparatus comprising a reservoir from which is fed an insecticide to a nozzle device, air pressure being used to generate a forceful jet at the nozzle for effectively distributing the insecticide over the area to be covered whereby various forms of insects may be destroyed.

Of General Interest

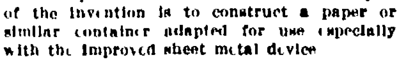
PEN.—R. I. FATES, Coalgate, Okla. The invention relates to a pen including a nib and a holder therefor, the holder being adapted to receive a pen staff. The form and arrangement of the elements result in strength and simplicity, convenience in changing the nib, insures a firm holding of the nib and provides for an ample supply of ink and a free feed of the ink.

MASSAGE APPARATUS.—H. L. CRANE, 182 St. Nicholas Ave., New York, N. Y. This device is intended for self treatment and is in the form of a hollow body having a concave surface used for massaging the tissues by the body being rubbed over the surface of the part or parts to be treated, the body being hollow so as to contain a heating or cooling medium so as to have any desired effect on the tissues.

REINFORCED CONCRETE GROIN.—G. O. CASE, 1170 Broadway, New York, N. Y. This improvement relates to reinforced concrete groins or the like adapted for erection along the shores of lakes, rivers or seas and has particular reference to means adapting such groins to be erected in sections applied one to another without requirement for special machinery or driving of piles or the like.

ENVELOPE LOCK.—G. F. SMITH, 12 Chatham Square, New York, N. Y. This invention pertains to sheet metal fasteners adapted especially for sealing or locking envelopes or other containers so that they can not be opened without detection. An object of the invention is to construct a paper or similar container adapted for use especially with the improved sheet metal device.

PEN ATTACHMENT.—E. VARLEY, P. O. Box 137, Pietermaritzburg, Natal, S. Africa. Mr. Varley's invention relates to pen attachments,



PEN ATTACHMENT

his more particular purpose being to provide a pen such for instance as is usually employed for writing or drawing with suitable means, whereby the ink carried by the pen point is prevented from reaching the surface of a ruler, a straight edge or the like employed for guiding the pen.

UTILIZATION OF KELP AND SIMILAR AQUATIC PLANTS.—T. BORRBU, Fairlawn, Clarence Road, Clapham Park, London, S. W. and N. TYRRELL, 3 Dean Farrar Street, London, S. W., England. This invention relates to the utilization of kelp and similar aquatic plants for the recovery of sodium and potassium salts or iodin or both therefrom and is particularly applicable to the treatment of giant kelps in which the alkali salts are present in amount to represent a value greater even than that of the iodin.

PROCESS OF MAKING NUTS.—A. H. JONES, 66 Mead St., Newark, N. J. The improvement provides a process whereby a longitudinal toothed bar is wound into a helix with the teeth on the bar forming an interior continuous thread. The so formed helical member can then be served into sections of predetermined length thereby forming helical nuts which are resilient and self locking.

EXPANSION AND FASTENING DEVICE.—G. C. RAEGER, Waterloo, N. Y. The invention provides a device, which is arranged for use in concrete walls, posts and other structures, to permit of conveniently locking the device in position in a hole in a structure, and at the same time fastening a pipe, rod, wire, or other article in place on the structure.

OIL-WELL PUMP.—C. A. BUTLER, 120 North Alabama Ave., Okmulgee, Okla. This invention relates to oil well pumps wherein the gas in the well is utilized for driving the oil from the well. It provides a simple, inexpensive valveless pump, which is automatic in its action, and which will require little or no attention, as there are no parts apt to get out of order.

MANUFACTURE OF PRESSED YEAST.—J. EFFRONT, 73 Avenue de Solbosch, Brussels, Belgium, and A. BOIDIN, Seclin, Nord, France. This invention wholly or partially dispenses with the use of malt and increases the yield of yeast and alcohol. This is attained by submitting the grain or other amylaceous material to a special fermentation by the aid of micro-organisms in the course of which the nitrogenous substances of the cereals, etc., are rapidly rendered soluble and peptonized with out losses of fermentable materials due to malting.

PROCESS FOR MAKING BREAD.—S. F. MCDONALD, care of Memphis Bread Co., Memphis, Tenn. In this process the addition of salt to the dough is made after it has been fermented for from four to seven hours, which is the time ordinarily required for proper fermentation. The salt is added through the dusters of the dough shaping machines by either dusting the salt on to the dough or the parts of the machines which shape receive or carry the dough. The process not only obtains a better salt flavor of the bread but economizes on the dusting material used at present for salt is cheaper than flour.

BIRD PERCH.—C. W. MUELLER, 1099 Summit Ave., Jersey City, N. J. Among the principal objects the present invention has in view are: To provide a removable perch for birds; to facilitate by the removal of perches of the character named the cleaning of bird houses and to reduce the cost of manufacture and simplify the construction.

SMOKE CONSUMER.—O. W. KING, Fort Worden, Wash. The present invention relates generally to improvements in smoke consumers adaptable in connection with smelters, furnaces and like apparatus and arranged to effectively withdraw the smoke and poisonous gases therefrom with a desired quantity of air for final disposition at another point.

SCHOOL DESK AND SEAT.—F. W. ELSS, Oskaloosa, Iowa. This improvement provides a school desk and seat provided with two side frames spaced apart, and with means to adjust a seat and a book pocket on the frames so that the seat is pivoted and the book pocket is secured to the frames at any desired height, and also so that the seat or book pocket will extend at the front and the rear of the frames as desired.

Hardware and Tools

TOOL FOR REMOVING BOILER SCALE.—D. H. SMITH, Bankhead, Alberta, Canada. In the present patent the invention has reference more particularly to a pneumatic hammer for removing boiler scale and it is so constructed that it can be used where it is impossible to work effectively and conveniently with chisel bars or a hand hammer.

WINDOW BEAD FASTENER.—M. M. BENSTER, Gettysburg, S. D. This invention pertains to improvements in windows and more particularly to window beads and fasteners and has for its object to provide means for permitting the ready removal of window sashes and for holding them in place in operable position.

IMPACT TOOL.—C. EKBERG, 3816 Hoyt Ave., Everett, Wash. This invention relates to improvements in impact tools wherein a reciprocating piston is operated by fluid pressure such as compressed air and in which the piston serves the purpose of a hammer to strike successive and numerous blows against the tool shank for cutting, calking or riveting in metal or stone work and various other purposes.

HAMMER.—J. T. HALL, 317 N. 11th St., Waco, Tex. This invention provides a hammer having a starting claw arranged adjacent to the central portion of the hammer near the point at which the hammer head is connected with the handle and adapted to be utilized in starting nails and the like which are difficult of extraction, in such manner that the strain on the handle and hammer head will be minimized.

WOOD SCREW.—W. R. SWEET, Wakefield, R. I. The purpose here is to provide a wood screw which is simple in construction easily screwed into wood or other material and arranged to lock the screw against accidental unscrewing and to prevent water or moisture from leaking past the head of the screw into the material.

Heating and Lighting

GAS PRESSURE REGULATOR.—B. M. GATTERMEIR, California, Mo. This improvement has reference to means for automatically controlling the supply of gas in the degree of use and the main object thereof is to provide such means which are an improvement over devices of this class now known to the inventor both structurally and in use.

GAS LIGHTING SYSTEM.—D. D. CORNING, Cedar Falls, Iowa. This invention improves and simplifies the construction of a combined gas valve and circuit switch so as to be reliable and efficient in use and so designed that the turning on and off of the gas and opening and closing of the ignition circuit can be easily accomplished.

Household Utilities

FOLDING CRIB.—E. ANDERSON, 750 51st St., Brooklyn, New York, N. Y. The improvement provides a structure which may be folded to occupy the minimum space when stored, arranges the members so that when folded the parts will be mutually held from movement, provides locking devices for the folding members, and devices being adapted to hold the out-of-service position; and provides easy access to the crib.

BOILER FUELING RECORDER.—T. FULSHAW, 73 W. 38th St., Bayonne, N. J. This invention relates to stoves and furnaces, and has particular reference to indicating and recording means whereby a permanent record is made of the times when the furnace doors are opened, and a record is made of the length of time the doors are left open.

GAS STOVE.—F. B. JACKSON and A. B. VESPER. Address the latter, 201 W. 29th St., Indianapolis, Ind. This invention utilizes the gas supply pipe to constitute the guard for the gas cocks. The supply pipe is positioned horizontally in front of the gas cocks and nearly at the level thereof, at a distance to permit the cocks to turn in an arc from the closed to the open position in an outward direction, so that when the cock is open the handle will be disposed at right angles to the gas supply pipe, and its outer end adjacent to the gas pipe and protected thereby, although projecting somewhat above the gas pipe to be conveniently grasped.

PIE PAN.—MARGARET L. NOXON, 205 W. 102nd St., New York, N. Y. This pie pan can be manufactured at little cost, and has an inner head spaced from the top of the pan and positioned to secure the sides of the under crust to permit of the upper crust being pressed there against, while the edges of the upper and lower crusts may be pressed against the fluted edge of the pan above the head.

DRAWER ATTACHMENT FOR BEDSTEADS.—H. M. DANIEL, Gulfport, Miss. This invention relates more particularly to means whereby drawers may be suspended in slidable relation beneath a bedstead frame or similar structure, for the purpose of economizing in room space and provides means forming guides for the slidable reception of drawers beneath a bedstead frame and the like, together with a cover plate for effectively covering and holding the drawers in closed position beneath the frame from which they are suspended.

STAIR TREAD.—H. ENGEMANN, No. 2 Tuck Apartments, Salt Lake City, Utah. This inventor provides a stair tread of such nature as to economize the use of carpet or other material employed, by eliminating the use of the carpet on the risers of the stairway, and provides for the exposure at will of previously protected fresh sections or areas of the carpet to replace the portions which have become worn and disfigured so that in time all of the material will be used before such material is discarded.

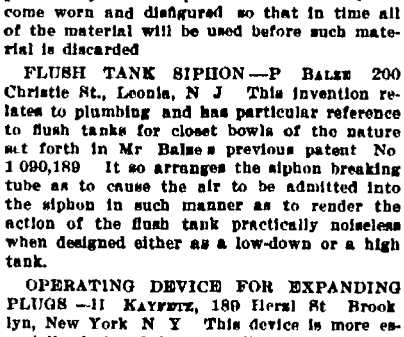
FLUSH TANK SIPHON.—P. BALSE, 200 Christie St., Leonia, N. J. This invention relates to plumbing and has particular reference to flush tanks for closet bowls of the nature set forth in Mr. Balse's previous patent No. 1,090,189. It so arranges the siphon breaking tube as to cause the air to be admitted into the siphon in such manner as to render the action of the flush tank practically noiseless when designed either as a low-down or a high tank.

OPERATING DEVICE FOR EXPANDING PLUGS.—H. KAYFETZ, 189 Hersl St., Brooklyn, New York, N. Y. This device is more especially designed for expanding a plug in the pipe leading to a sewer to permit of making a house test of the plumbing and arranged to permit the plumber to conveniently place the operating device in position together with the plug and to actuate the operating device with a view to expand the plug by means controlled exteriorly of the pipe.

Machines and Mechanical Devices

DOBBY OR JACQUARD OF WEAVING LOOMS.—GEORGES E. LEVY, Paris, France. The present invention consists in mounting the shedding bars on supports, directly connected by metallic connecting bars with the rocking levers, each shedding bar slides transversely from left to right, and inversely on its support which serves as a guide, while the support always remains in alignment with the traction of the connecting bars.

PIPE THREADING MACHINE.—W. E. NEWTON, 821 5th Ave., Hunting, W. Va. This invention is an improvement in pipe threading machines, and has for its object the provision



PIPE THREADING MACHINE.

of a portable machine of the character specified, especially adapted for cutting threads on large pipes at the place of their utilization, and wherein the machine may be operated manually, being placed directly on the pipe.

ANIMAL TRAP.—C. BUTZELMANN, 1 3 Brenner St., Newark, N. J. The object in this case is to provide a new and improved animal trap, which is very simple and durable in construction, cheap to manufacture easily set up and

(Concluded on page 484)

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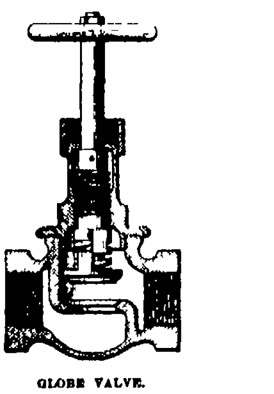
(Concluded from page 432)

arranged to take up very little room to permit of conveniently placing the trap in position at almost any place

GLOBE VALVE.—W H JOHNSON Address F Cuth 28 W 71st St Chicago Ill The improvement has for its object to provide a



GLOBE VALVE.

valve so arranged that whenever the valve is opened or closed, it will be turned or ground on its seat, to provide for an intermittent regrinding on the contact surfaces of the valve and seat and wherein the grinding pressure is for a portion of the time during the opening and closing of the valve under full pressure

GATE OPERATING MECHANISM — E PHELPS 30 Longwood Ave, Brookline Mass The invention relates to gates and more particularly to gate operating mechanisms where by a gate can be opened from a point at either side thereof without the driver or rider being required to get off the vehicle or horse for the purpose of manually opening the gate in the ordinary manner

VALVE MECHANISM FOR TRAPS—G W MOHR 182 Central Ave Jersey City N J This inventor provides a valve mechanism for traps, which is exceedingly sensitive and arranged to insure a positive opening and closing of the outlet to periodically drain off the accumulated liquid from the trap without danger of the working parts becoming inoperative by sticking or other causes.

VENDING MACHINE COIL CONTROL —N O TRAVERSE General Delivery Minneapolis, Minn In the present patent the invention has reference to vending machines, and relates more particularly to the check or coin control of vending machines An object of the invention is the provision of a simple, automatic, and inexpensive coin control

LATCH KEEPER FOR EXCAVATOR DIPPERS —E F COLBATH, Rockland Lake, N Y The invention relates to excavators or dredges, and has particular reference to the construction of dippers employed in excavating or dredging operations. An object of the invention is to improve the construction of an excavator or dredger dipper with reference especially to the latch keeper thereof for the door

CONCRETE WALL MACHINE —M DEEKS, Rochelle Park, N J This invention relates to apparatus for building plastic or concrete walls and has particular reference to devices of this nature adapted for continuous operation for forming a wall in courses one above another in a rapid and reliable manner It simplifies the construction and operation of machines of this nature adapted for forming a hollow wall or a wall having inner and outer portions with an air space between them.

NUT TAPPING MACHINE —T M DANIELS and J C HOLSCHEMACHER Address the former 208 South La Salle St, Chicago Ill The main object of the invention is to render any of the top spindles inoperative in the event of the nut blank thereunder being defective either by being under size or by not having been provided with the hole to be tapped It provides means in such event, for removing the defective blank from the machine automatically

TRANSPORTABLE APPARATUS FOR ACTUATING TOOLS OR MACHINES —M BOUCHET 22 Rue Alphonse de Neuville, Paris, France This invention relates to an apparatus capable of constituting various machines such as saws of any kind boring and grinding machines, etc or of serving for actuating various machines, such as pumps agricultural implements, etc It is arranged to be used for multiple purposes and to operate in any position so as to avoid moving the work or the machine to be actuated

AUTOMATIC VALVE OPERATING MECHANISM —I M BALDWIN Address F F Aldridge care of American Thermostat Co., 103 Mechanic St, Newark, N J This invention provides means for operating valves which may be connected with a thermostat to be actuated thereby The thermostat has means for closing circuits connected for driving a motor for rotating a wheel or disk which has cams for engaging a thrust rod connected with a valve stem for operating the valve Means provide for continuing the running for a period even if the thermostat should move to open the circuit disposed at the thermostat

PRESSURE REGULATOR.—J P METZGER, Address J S Leslie, care of the Leslie Co., Lyndhurst, N J The invention relates to pressure regulators in which a main or regulating valve is controlled by a piston governed by controlling means controlled by low pressure from the outlet side of the regulator to admit high pressure from the inlet side of the regulator Mr Metzger has invented another pressure regulator, which relates to pressure regulators in which the main or regulating valve is controlled by a piston governed by controlling means controlled by low pressure from the outlet side of the regulator to admit high pressure from the inlet side of the regulator

SCALE OR WEIGHING DEVICE—J P CLIFFORD, 70 Grove St Passaic N J This invention provides scales for weighing large amounts and indicating the amount of over weight upon each weighing operation so that the exact amount will be recorded It provides a scale to weigh a predetermined amount but adapted to indicate the correct weight of a lesser amount, and also the correct weight of a greater amount

RESUSCITATOR —T E ACKLEN, care of Acklen Bros 237 239 E McLemore Ave, Memphis Tenn This device is for use with persons suffering from suspended respiration, and wherein mechanism is provided adapted to be secured in place on the upper portion of the abdomen and adjacent portion of the stomach, for moving the wall of the abdomen outward and inward in a manner simulating respiration, in order to restore the function of breathing

DRIVING BELT —E HOWL, The Quarries, near Dudley and F PERRY, Shrubbery Bloomfield Road, Tipton, England The object of the invention is to provide a practical extensible belt capable of producing useful variation of speed ratio, and the invention comprises an extensible or elastic belt having certain properties and having arranged therewith inextensible or inelastic parts adapted to make driving contact with the pulleys on the shafts

AUTOMATIC CAMERA SHUTTER LOCK — P HOLT and R G HOLT 122 Francis St, Providence R I This invention provides a stop structure which will positively prevent a second operation of the shutter until the stop has been released It provides a mechanism connected with the film shifting structure, and with the shutter whereby the film shifting mechanism may release the locking mechanism arranged adjacent the shutter in order that one exposure may be produced for each film

BAIT OR DRAWING TOOL HOLDING DEVICE —S B HENSHAW care of Charleston Window Glass Co Charleston W Va This improvement provides a support for the bait or drawing tool which will enable the strain of its weight being taken from the cylinder laid out for capping and which will withdraw the bait a sufficient distance from the cylinder after the latter is cut off from the bait, to prevent checking or tipping of the adjacent cylinder end

VIBRATOR —P J JOECKEN 2651 E 79th St, Cleveland Ohio The invention provides a device operating by fluid under pressure, and wherein a cylinder is provided and a piston in the cylinder and wherein valve mechanism is provided in connection with the cylinder for operating the piston to positively force the same in opposite directions

Musical Instruments

KEYED ZITHER —I JOST Address OSCAR SCHMIDT, 87 Ferry St North Bergen, N J The object of the invention is to provide a new and improved keyed zither which is very simple and durable in construction easily manipulated and arranged to enable the player to conveniently actuate the spring hammers for sounding the melody strings

Prime Movers and Their Accessories

WATER CIRCULATION SYSTEM FOR EXPLOSION ENGINES —W K LEGGETT care of Eugene Phillips 213 Francis St., Jackson Mich This inventor provides an attachment designed to be interposed between the exhaust of the engine and the water line of the radiator for utilizing the impulses of the exhaust to supply cold air to the radiator or engine for cooling the same, and aiding the circulation of the water

CARBURETER —G A BOYCE, Edgemont Nev The carbureter is provided with an adjustable fuel nozzle and an adjustable air intake at the nozzle with means for regulating the nozzle and the air intake simultaneously so that the velocity of the air at the air intake is substantially the same at all times, to vaporize the fuel perfectly whether the carbureter is wide open or partially closed

ROTARY ENGINE —E F O HAVER, Box 381, Carlisle, Ind This invention produces a rotary engine having comparatively few parts, and so arranged that the movement of the rotary piston causes the latter to directly engage, and operate step by step a single revoluble member which performs many of the functions usually performed by more complicated mechanism for applying power to the piston

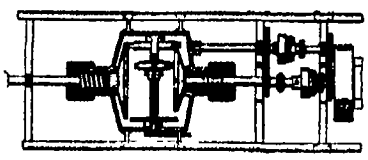
Pertaining to Recreation

SLEEPING EYES FOR DOLLS —O E DENIVELLE, care of the Denivelle Co Inc 42 Wooster St New York, N Y This invention provides sleeping eyes for dolls, arranged to permit each eye to move into open or closed position independently one of the other to insure free movement of the eyeballs. It provides a construction to allow of manufacturing the doll s head very economically

Pertaining to Vehicles

AUTOMATIC STARTER FOR AUTOMOBILES —O E WOOLDRIDGE, 117 South 6th St., Greenville, Ill, This invention provides means for mechanically cranking an automobile engine provides means for manually controlling the same, provides means for automatically governing the stored power of said cranking means, and simplifies the mechanism and condenses the space occupied thereby

DIRECT DRIVE FRICTION TRANSMISSION —C S. ALLEN 337 Mills Blg., San Francisco, Cal This invention provides a device having a few parts, and these of a simple



DIRECT DRIVE FRICTION TRANSMISSION

nature therefore eliminating troubles due to a multiplicity of complex elements. It provides a transmission mechanism whose use will insure the longer life of all the parts of the car, such as engines chassis and tires, due to the fact that jerks and jars such as that caused by changing gears, are entirely eliminated.

VEHICLE TIRE —J MONSON, 201 E 30th St. New York, N Y An object in this invention is to provide a non pneumatic tire which offers a gradually increasing resistance to stress exerted upon it. A further object is to provide a tire and wheel construction comprising means for fastening the tire to the felly of the wheel

WAGON JACK —R AMES, 528 Rookery Block, Spokane Wash The prime object of this improvement is to provide a wagon jack having means to engage a vehicle wheel in a manner to lift the wheel and axle, and to give a sliding movement to the wheel relatively to the axle to remove the wheel or restore the same to its position on the axle

LIFTING JACK — W W BELL, Beaver Creek, Minn The object of the present invention is to provide a lifting jack having elements thereof so disposed that the strains in operating the jack will be distributed A further object is to increase the efficiency of jacks and to promote convenience in the operation of the jack and in the adjustment of the parts.

VEHICLE WHEEL —J C SMITH, 2112 5th Ave, Birmingham Ala. The invention refers more particularly to wheels designed to be used on automobiles and heavy trucks, the object being to provide a wheel which shall have positive traction and be cushioned to utilize the benefits of pneumatic tires without the danger of puncture or to use spring pressure, or combined pneumatic and spring pressure

SIGNALING DEVICE —A R. COLGIN, 916 Napier Ave, Richmond Hills, N Y This invention provides a device more especially designed for use on automobiles and other vehicles and arranged to enable the driver to readily signal ahead to oncoming vehicles and to persons intending to cross a highway in front of the vehicle and to signal rearwardly to following vehicles the intention of turning out to the right or to the left during the day or the night.

BRAKE FOR PLATFORM TRUCKS —J L SMITH care of S & S Mfg Co, Savannah, Mo This invention relates to platform trucks such as used at railway stations, and provides means for preventing a truck from being run off the railway platform, as by suction or jarring caused by a rapidly moving train or by winds and likely to cause serious accidents if the truck rolls or falls upon the rails in advance of an approaching train

SPRING TIRE.—H M LAMBERT, care of Lambert Multiplus Co, Portland, Ore This invention is an improvement in spring tires, and has for its object to provide a tire of the character specified, which while having a large amount of resiliency will not be injured by puncture, and wherein means is provided for permitting the resiliency of the tire to be varied.

AUTOMOBILE BODY AND WATER BAG PROTECTOR.—F B SULLIVAN Address T A Lots P O Box 417, Carson City, Nev This device is for use with automobiles and other motor vehicles, and comprises a bag of flexible material such as canvas or the like having means for connecting the same with the body of the vehicle to support the bag in inclined position between the fore and rear doors, in such manner that the bag will not mar or injure the body, and will be yieldingly supported to prevent injury to its contents

DIFFERENTIAL LOCK AND TRANSMISSION CONTROLLER.—F H TRSGO, care of Knox Motors Co., Springfield, Mass. This invention improves and simplifies the construction and operation of the apparatus so as to be efficient in use, and having locking means whereby only one gear can be thrown in at a time, and when the gears of the transmission are in meshing relation the differential gearing cannot be thrown in.

TIMER AND DISTRIBUTER.—D E. MOULTON, Pierre, S. D. The object here is to provide a simple, compact, efficient and inexpensive device, the parts of which are so related that the same can be easily inspected or cleaned when necessary and the relation of which parts is such that they require little attention, and the same are self-adjusted.

COMBINATION RIGID AND FLEXIBLE FRAME FOR MOTOR CYCLES —C. D. CONGDON, 404 Bleecker St., New York, N. Y. The invention relates to means for [illegible] supporting the rear fork of a motor cycle, or other form of velocipede, to yield relatively to the rigid frame. Its object is to provide a means for the indicated purpose, improved in various particulars, to the end that efficiency may be promoted in effecting the assemblage and adjustment of the parts.

SAFETY DEVICE FOR AUTOMOBILES.—E U MACK, 327 E. Palmetto St., Florence, S. C. This invention relates to the starting of internal combustion engines, in automobiles, particularly of the Ford type, and provides means preventing the starting of an engine unless the commutator is in the correct position for starting the engine, as, if the commutator should be "advanced" when the crank is joined to the crank-shaft and revolved to rotate the said shaft, back fire results and a broken arm may result.

VEHICLE SKEIN —W W WOOD, JR., Huntington, L. I., N Y This invention relates to improvements in vehicle skeins, and has for its object to provide a construction which is automatically self lubricating. It provides a skein for a vehicle axle which will act in the usual manner of skeins of this character while forming a fountain lubricating structure.

AUTOMATIC LUBRICATING HUB.—M. L SENDERLING, 333 Fairmount Ave., Jersey City N J The inventor provides a device for redistributing the lubricant to the supply thereof with which the wheel is furnished provides means for retaining the lubricant with which the axle is provided within the hub of a wheel, and provides a means for holding in place the dust-guard provided on wheels of this character

WHEELED SCRAPER —H C ROWELL, R F D No 8 Modesto Cal This invention relates to grading and excavating devices, and more particularly to a wheeled scraper An object is the provision of a novel dumping means for the scraper, whereby it is rendered unnecessary to tilt the entire structure in order to unload the contents thereof.

Designs

DESIGN FOR A SOCKET COVER FOR LIGHTING FIXTURES — S SHAPIRO, 15 Laight St., New York N Y The socket cover in this case when viewed in its front, side, and rear positions shows an article of highly attractive simplicity and graceful lines. Mr Shapiro has also made a design for an oval back for brackets for lighting fixtures. In the side and bottom plan views the article represents ornamental features of effective neatness and beautiful lines.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—S. GEISMAN, 27 Spruce St, New York N Y This ornamental design for an article of manufacture shows a wonderfully original assemblage of grotesque animal monsters Oriental human figures idols, and numerous accessories In another design for an article of manufacture Mr Geisman shows a plan view, the field of which presents a remarkable variety of outlines, amid which appear both lightly and deeply mottled effects numerously pointed with small and heavy dots The same inventor has made an ornamental design for an article of manufacture which represents an original massing of butterflies and flowers. In still another design for an article of manufacture, Mr Geisman represents the article in alternate band effects, plain and then hatched.

DESIGN FOR A LADY'S HAND-BAG — ELSA DIENEMAN 8675 20th Ave, Brooklyn, New York N Y The article of manufacture in this case is shown on the attractive formation of a hand bag simulating a dressed doll having a wide or flaring skirt constituting the bag proper, while the bust portion constitutes the closure Ribbon hangers serve as the handle

DESIGN FOR A FOUNTAIN.—T LLOYD 40 Northfield St, Boston, Mass. This design comprises an upright tank having flat faces, the height of the tank being greater than the width and the width being greater than the depth from front to rear, but tapering toward the base The base has a circular flaring front flange, and an arc-shaped arch spanning the rear portion of the base and secured to the front portion of the tank.

DESIGN FOR A TOY STORE.—M. UNGAR and E. S BECKER, 1012 Fox St., Bronx, New York, N Y The front view of this construction of a toy store shows an original design, the top of the store having an ornamental sign inscribed with the words, Dr Pill & Co., Druggists. A branch in every home. The second view illustrates a transverse section of the store.

DESIGN FOR AN ENGAGEMENT RING.—H. ROMER, Address B. ROMER & Co., 45 John St., New York, N Y Between the body of the ring and the stone carrying crown appear two interlinked hearts pierced by an arrow The open frame work on both sides of the ring is flanked by connecting bars extending tangentially from the ring body to the crown. The second design shows an edge view of the ring.

DESIGN FOR AN ARTICLE OF MANUFACTURE —E. BOOTH, 35 W. 23rd St., New York, N Y This ornamental design shows the article in circular form and richly ornamented with running flowered vine border with a center comprising a flower plant on a stick of which is perched a beautiful bird.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Portable Apparatus for the Detection of Combustible Gases in Air

(*Concluded from page 422*)

and natural gas one for hydrogen one for gasoline vapor and one for coal gas

The electrical energy for heating the platinum wire is derived from a miner's electric cap lamp storage battery thereby providing the electric cap lamp with a gas detector, this is something it does not possess at present yet it has been an objection to the use of electric lamps in gaseous mines.

In Fig. 3 is shown another gas detector similar in operation except that it contains two small dry cells *A* and *B*, for supplying the electrical energy These cells cost but a small sum and will operate the detector for a minimum of twenty determinations When they are exhausted, their renewal is a simple matter

The patent rights on the gas detectors just described belong to the Bureau of Mines. Plans are under way to exploit the instruments in such a way that the public interest will best be served.

War Game—VI.

(*Concluded from page 428*)

Greenville, 7 June 19— 7 00 P M

To Colonel K.,

Argus Farmhouse.

One regiment of Red cavalry passed this village at 8.30 P M As far as could be ascertained, it is independent cavalry of the main forces coming from the North. No other enemy has been seen

I shall continue reconnaissance toward *Leopard*

L.,

Lieutenant, Ninth Cavalry

It is evident that this is the report of a patrol which was sent out by Colonel K during the day to gain more information of the enemy This patrol is part of the squadron which has been active since early morning

Message from Brigade Commander

Morrisville 7 June 19— 5 00 P M

To Colonel K,

Argus Farm

According to reports from our aerial scouts, an enemy brigade coming from the North has camped near *Delroy*

This brigade marches at 9 00 P.M today, via *Deansville* and *Oregon Farm*, to envelope right flank of enemy in your front.

In order to establish our position securely north of the *Nehaminy*, you will hold your position along the crest of *Lookout Hill*

I shall ride with the advance guard.

G,

Brigadier General

Report from Patrol

Coal Mines Ferry 7 June 19— 7 30 P M

To Colonel K,

Argus Farm.

Enemy patrols have succeeded in repairing ferry boat. A Red platoon has occupied *Ferry House* and prepared it for defense Messengers were sent north on *Delroy* road

I remain in observation

S/1,

Sergeant, Ninth Cavalry

It is evident that the proposed concerted action of the detachment under Colonel K., now on Lookout Hill, and of the First Infantry Brigade under General G, will effect a great change in the situation The Blues, upon the arrival of the Brigade, will possess a force far superior to that of the enemy

We must now consider what the Red Commander, Lieutenant Colonel LC., will do

At dusk, all the advantages were on the side of the Reds. The reader had a clear picture of the position and situation of the Blues, and it will be interesting to consider here just what plans Lieutenant-Colonel LC. would make, were he in possession of all the information which we have.

We must assume that the Red patrols have been and still are doing their duty It will be remembered that a Red patrol, in War Game IV, reported that a strong Blue force had been observed moving towards Morrisville. Delroy, mentioned in

the message from Brigade headquarters, is about 25 miles from Lookout Hill.

The plans of Lieutenant Colonel LO will be explained later

The Dispositions of Colonel K of the Blue Detachment

We will return to Colonel K at the time when he has considered the important reports and messages which he has received These will constitute the basis for his order, which he will dictate to the commanders of the four infantry battalions and the battery These officers have been directed to report to him for orders.

"The enemy force in our front consists of one regiment of infantry, one regiment of cavalry and one battery A Red brigade has been observed about 25 miles north

'Our First Infantry Brigade is advancing via the *Dansville Greenville* road to envelope the enemy's right flank They should arrive about 1 00 A M

"We will hold our present position

'The battery will withdraw behind *Argus Farm*

Reserve will move from its present position to the eastern edge of the forest One company from the artillery support will reenforce the left flank guard and act as its reserve

"Engineers will assist in construction of entrenchments

'All reserve ammunition will be issued to the firing line

Field kitchens will at once issue food to the firing line

'Wounded will be transferred to *Potts town* Dressing station will be established at eastern edge of *Pine Forest*

'I shall remain here"

* * * * * * * * *

The officers repeat their orders and depart During the night an occasional shot is fired while on the road farther south the blue brigade is advancing to the attack

Questions

Question 1 With the information given in this and in previous War Games, locate on the map the positions of the Reds and the Blues.

Question 2 About how much of the Blue reserves have been used up in the day's combat?

Question 3. What advantage does the Blue artillery gain by moving back of the crest of Lookout Hill?

Question 4 How will the Blue artillery direct its fire?

Question 5 What features of the terrain must Lieutenant Colonel LC, commander of the Reds, consider when he receives information that overwhelming enemy forces are threatening his right flank?

Question 7 In order to avoid defeat and the destruction of his force, what will be the decision of Lieutenant Colonel LC? What will be his orders?

Answers to Questions in War Game V.

1. In answering this question we will assume that Lieutenant Colonel LC made his decision 15 minutes after the partial repulse of the Red cavalry which ended in their withdrawal and dismounting for fire action The order which he gave was as follows

"The enemy, with a force of four battalions of infantry and a battery, is advancing from *Lookout Hill* against our position on *Timcum Creek*.

"We will attack the enemy on *Lookout Hill*, enveloping his right flank.

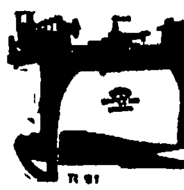
"The infantry will cross *Timoum Creek* and attack the enemy's right flank.

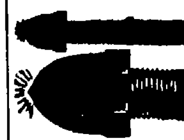
"The cavalry will establish communication with the detachment 1,000 yards west of *Argus Farm*, and will attack enemy's position on *Lookout Hill*, advancing in the direction of *Argus Farm*.

"The battery will cover the crossing of the detachment and then concentrate its fire on the enemy's right flank.

"I shall remain near the bridge."

2. See map.
3. See map.
4. Without doubt, the left flank of the Blues. The reason for this is that this flank is really the only vulnerable spot of





the Blue position. In addition, a successful attack against the Blue left flank would secure the commanding top of the Hill for the Reds.

5. The immediate result of the gaining of the highest point by the Reds would be the threatening of the Blues' left flank, which would necessitate their farther withdrawal.

We know that the mission of the Blue forces is to hold the bridges over the Neshaminy river above Pottstown. If the Reds succeed in taking the high point in question, they would from this position command the two bridges and their artillery could either destroy them or make the crossing very difficult for the Blues.

6. In answering this question, the terrain is the decisive factor. The difficulty of making an advance across the bridge is great enough, but that is very little as compared with the crossing of the bridge in a retreat. Such a retreat would undoubtedly involve a complete disaster. On the other hand, the good defensive line of Lebanon Forest, with the lake guarding the flank, would make such a retreat easy.

7. This question has been fully answered in the plan for the attack enveloping the right flank of the Reds.

* * * * * * * *

Developments of Importance

At 4.00 A.M., on the 8th of June the Blue forces open up a heavy fire against the Red line. The fire superiority of the forces making the enveloping attack compels the Red right to withdraw.

The following articles will discuss the retreat of the Reds, and the assistance of the engineer troops in making a double envelopment of the Red forces.

Civilian Motor Trucks as Army Supply Trains

(Concluded from page 423)

The convoy formation of the train was made up of a scout car, then one of the lieutenant's cars, then the commissary truck followed by the four burden bearing trucks. The commander's car was next in order, followed by that of his orderly. Then came the repair truck, followed by another lieutenant's car with two orderlies in cars at the extreme rear. The lieutenants and their orderlies in the performance of their duties naturally deviated from these positions from time to time.

The personnel of officers was as follows: Commander, Arthur J. Slade, formerly a member of Squadron A; Lieutenants Roderick Stephens and George H. Pride. R. D. Dumont, 23rd Regiment, N. G. N. Y., was in charge of the commissary.

The results of the trip showed that fully loaded trucks of from 5- to 6-ton capacity could negotiate with ease even the worst of the roads if they had any foundations at all. Even grades of from 5 to 7 per cent on dirt roads were traversed with but little delay, as is evidenced by the fact that the average running speed of the train over the entire trip was 6.2 miles per hour.

At one spot, just out of New City on the return trip the road was so soft that it was decided to send the trucks through it in pairs, the first towing the second, the idea being that if one of them lost traction the other might have enough to pull both through. The first pair got through without trouble, and the third was sent over the soft spot alone. It got mired, but the repair truck pulled it out in less than five minutes by its tow rope. By rushing the soft spot and straddling the rut, the other three trucks got through without aid. This brought out the fact that heavy trucks do not sink deeper into the soft roads than lighter ones, for the reason that the tire widths of each are in proportion to their loads, due to the limited capacity of the rubber in the tires. In fact, the larger width tires have sort of a rolling effect on the road, tending to flatten out the ruts if the road has any kind of foundation.

The maintained average speed of 6.2 miles per hour over the bad roads and the steep grades was a revelation to the army

observers, so much so to one of them that he volunteered to aid in laying out a military problem for a future truck run in which small and large trucks will be made to carry their respective loads over the same route with a view to comparing their efficiency directly

While it was admitted that in cross-country running, trucks of light capacity probably are more efficient than heavier ones, because of the elimination of the rolling effect of the wide tires, due to the lack of road foundation, it was pointed out that only about 10 or 15 per cent of the transportation of the 175 000 pounds of supplies which are required daily by an army division is cross-country work the remainder being expressed in the haul from the rear base to the one nearest the *actual fighting line* It is in this particular work in which the heavy-capacity motor truck stands pre-eminent, for this class of transportation is not vastly different from commercial haulage in that the problem remains simply the transportation of a certain amount of goods over a certain route in the minimum of time Where there are heavy loads to be hauled commercial users of trucks have found that the larger the unit of goods hauled *per vehicle, the less cost per ton*

Another very important advantage of large over small trucks for army transport work is that the number of the former to carry a certain given tonnage takes up less road space than the latter This advantage cannot be overlooked, for it provides so much more road space for the passage of troops

Aside from the question of capacity, the trip brought out forcibly the need for some form of day and night signaling devices to enable officers at one point of the train to communicate with those at others In several cases the roads were so narrow that even the officers passenger car could not pass one of the trucks en route without becoming mired If the trucks left the center of the road, they too became mired. Motorcycles are out of the question except on good roads Whether the solution of this problem will be the development of a semaphore arrangement on each truck for day work or searchlight flashes or tail light signaling at night remains to be seen

NEW BOOKS, ETC.

STARTING LIGHTING AND IGNITION SYSTEMS Elementary Principles, Practical Application Wiring Diagrams and Repair Hints By Victor Pagé, M E New York The Norman W Henley Publishing Co 1916 8vo, 509 pp illustrated by 295 specially made engravings Price $1 50

A notable addition to the literature of automobile electricity is this compact volume by a well known writer and expert The last two or three years have witnessed many changes and improvements in starting, lighting and ignition accessories and motorist and repairman must continually familiarise themselves with the new variations in practice This handbook provides the maximum of information in the minimum of space and every detail is made distinct and explicit A discussion of elementary electricity clears the way for the specialized information of succeeding chapters the work then takes up, in turn battery and coil ignition methods, magneto ignition systems elementary electric starter principles typical starting and lighting systems, and starting system faults and their systematic location As electricity is coming into popular use in the operation of many other accessory devices a final chapter is given over to these applications, among them being electric alarms, horns direction indicators, gear shifts, and brakes. Throughout, the reader is impressed by the convenient arrangement of material the many excellent illustrations which often make clear at a glance what would otherwise require long descriptions in the text, and the up-to-the-minute character of the information offered. It would be hard to conceive of a work better adapted to the needs of those in any way interested in that modern equipment of the automobile which so largely contributes to its safe, economical, and pleasurable operation and control.

CUBAN CANE SUGAR. By Robert Wiles. Indianapolis The Bobbs-Merrill Company, 1916. 16mo, 85 pp., illustrated Price, 75 cents net

"Cuban Cane Sugar" is a most attractive little treatise on an industry whose importance is not sufficiently appreciated The world's sugar crop is much larger than her cotton crop, and is surpassed only by the grain crops. Cuba, by virtue of the superior quality and depth of her soil, seems entitled to the by-name of "the world's sugar bowl." Mr. Wiles tells in an unusually entertaining manner the story of sugar, with particular reference to the Cuban industry, until the reader is familiarized with the history of the product from soil to sack. His book also contains much suggestion for increasing the output by improving the quality—and hence the sugar content—of the cane. While the work addresses itself to the general reader, it must appeal strongly to the investor Its array of reliable statistics and its suggestions toward agricultural and refining efficiency should make it particularly valuable to the man who is financially interested in sugar production.

A STUDENT'S BOOK ON SOILS AND MANURES By E. J Russell, D Sc. Cambridge England The University Press. New York G P Putnam s Sons, 1915 8vo, 206 pp., illustrated Price, 90 cents.

Successful crop production is so largely dependent upon the quality of the soil that the farmer is coming to recognise more and more the importance of a better understanding of soils and fertilisers. Dr Russell's work offers a course that assumes no knowledge of chemistry preferring to leave chemical explanation to the judgment of the teacher The first division of the work deals with the composition and the organic matter of the soil, and with the needs of the plant, together with a brief consideration of the effects of climate on fertility the second division takes up cultivation and the control of fertility, and the final section of the text is devoted to fertilisers. There are many illuminating illustrations and an appendix cites numerous methods of soil analysis

THE FINGER PRINT INSTRUCTOR. By Frederick Kuhne, Bureau of Criminal Identification, Police Department, City of New York New York Munn & Co Inc 1916. 8vo, 155 pp., illustrated Price, $2 net.

Seldom do we find a work that places before the student the whole science of an attractive uncrowded, and promising occupation, but this is precisely what Mr Kuhne of the Bureau of Criminal Identification, has done in "The Finger Print Instructor" The public knows little of this subject save what it gets from its fiction and the matter has hitherto been surrounded by an aura of mystery Yet as a means of identification the finger print has repeatedly shown its superiority over both handwriting and physical measurements. Handwriting *experts so often flatly contradict each other* that the judiciary and the public have lost faith in their testimony no such fiasco is likely to arise where a comparison of finger prints is in question here identification is quickly made or the evidence thrown out on positive and definite findings Even the Bertillon *system of physical measurements* presents great disadvantages when compared with the finger print method It calls for a costly and ponderous equipment, and for a high degree of proficiency its decisions may be arrived at only after long research, worse still the human body being an organism subject to growth and change the deductions of any measurement system are frequently inconclusive and open to argument. None of these drawbacks are found in the finger print method The equipment is simple, inexpensive and portable Definite conclusions are usually reached in less than five minutes. Its principles are applicable to any age from babyhood, through maturity to death and only decomposition can destroy the irrefutable testimony which the ridge-lines of the fingers disclose. As Mr Kuhne points out, the finger print system has so far been restricted—with the exceptions of the impressions of illiterates as taken by some savings banks and the identification of dead upon the battlefield—to criminal procedure but signs are not wanting that its sphere of usefulness is to be greatly extended Certainly the "scientific efficiency" movement cannot long ignore the admirable adaptability of this means of identification to the requirements of banks corporations, life insurance companies, the Immigration Bureau, and the Bureau of Elections In short, the finger print system bids fair to find its highest usefulness in industrial and financial life Again, were every citizen required to file impressions, it would mean immediate notification of his family or friends in the event of accident or death All sound reasoning must favor the general adoption of this system and it is safe to prophecy that its universal use would modify our criminal statistics by vastly increasing the difficulties of successful forgery and impersonation The author of the work in hand has every qualification for imparting to others an efficient knowledge of this fascinating occupation He has reduced intricacies to their simplest forms and difficulties melt away before his penetrating dissections and clean-cut explanations. The work is profusely illustrated with a large variety of actual finger impressions, and nothing of principle or practice is withheld from the reader Once the easy instructions are mastered, the student will find himself fully qualified to take and file prints, and to identify any individual from the filed records. A pocket in the cover of the book contains a number of facsimiles of the cards used for filing impressions, showing their actual appearance and the mode of designating the different varieties of impressions with which the operator comes in contact. Mr. Kuhne's work is based upon the Sir E. R. Henry system, and the comprehensive information and exposition it offers make it an invaluable [illegible] book for the expert, as well as a text for the student.

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THE NATIONAL WEEKLY

416 West 13th Street, New York City

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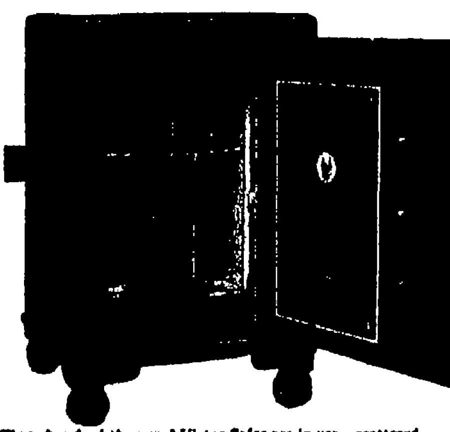

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GOOD ROAD BUILDING

Phillips Werner Road Rochester Indiana Before Treatment with Tarvia

How Tarvia Makes Durable, Dustless, Mudless Roads

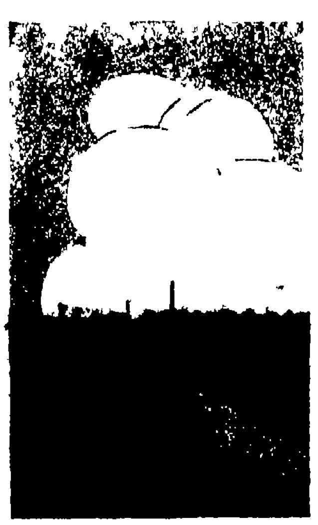
What You Already Know About Tarvia Roads—

YOU know, from the "ads" you have been seeing so long, that Tarvia Roads are *durable, smooth, resilient, dustless, mudless,* and at the start cost little more than ordinary macadam, and in the long run cost less

You know, from probable experience in motoring or driving over Tarvia Roads, (for they are now in nearly every section of our country), that all these statements of *quality* are facts

You know, (if a citizen in a Tarvia neighborhood), how Tarvia Roads have brought a new comfort to living, and have reduced distances by their splendid smoothness You know, (if a taxpayer in sections where Tarvia has been used), that the claims of superior economy are also facts

But, perhaps, you may not know, (not having sent for a Tarvia Booklet), how Tarvia Roads are made, and how the above results surely follow the process Here are a few facts that we think will interest you



Phillips Werner Road, Rochester Indiana Shows transformation of road surface after the use of "Tarvia-X

What Tarvia Is

Tarvia is a coal tar preparation, shipped in barrels or in tank cars
It is made in three grades, to be used according to road conditions viz

"Tarvia-X," "Tarvia-A," "Tarvia-B "

The chief use of Tarvia is for constructing and treating macadam roads,—to make them durable, smooth, resilient, dustless, mudless, waterproof

It is also used on concrete roads, on brick pavements, and even on good gravel roads,—to smooth out irregularities, to arrest disintegration, and for repairs

"Tarvia-X"

is always to be used when you are building a *new* macadam road, both as a binder and surface coating The old way in building macadam was to use *water* as a binder

But a water-bound macadam wears out quickly under the prying strain of the automobile driving-wheels and the horses' hoofs You know how that strain loosens the surface, grinds it into clouds of dust, makes heavy mud, and leaves the road full of holes

Results and Cost of "Tarvia-X"

With "Tarvia-X" in place of water, you have a road smooth enough to dance on—resilient enough for rubber tires to grip on without skidding, or for horses to trot on without slipping, without dust in dry weather—without slime in wet weather You have a road that *lasts*

The first cost of making a tarvia-macadam costs but little more than the old-fashioned macadam, but the saving in maintenance more than pays this difference So Tarvia costs you nothing!

"Tarvia-A"

is, practically a thin "Tarvia-X," used for re-coating the surface of a macadam road already built It is applied hot and adds greatly to the life of the road It keeps the road dustless, smooth, and inviting to traffic, but its use is confined to certain kinds of traffic to be economical

"Tarvia-B"

is a much more widely used preservative It is applied *cold* It is thin enough to sink quickly into the road, yet strong enough to bind the surface particles together into a dustless, durable surface "Tarvia-B" offers the lowest cost of road maintenance yet invented It can be used effectively, for repairing and preserving macadam roads under varying conditions of traffic and situation It may even be used effectively on certain classes of gravel, shell and adobe roads

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THE WAR GAME—VII

SCIENTIFIC AMERICAN

CABLEWAY AMBULANCE SYSTEM IN A PRECIPITOUS ALPINE REGION

April 29, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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Unique Equipment for the Unwatering of New York City's Great Aqueduct

By Robert G Skerrett

MUCH has been written about the various phases of the great aqueduct which is to carry water from the Catskill mountains to New York city a hundred and more miles away. General interest has been aroused in this engineering project which, in some particulars is a more difficult undertaking than the Panama Canal, but the public has been largely absorbed in the structural details pure and simple. The technical task however, is not that alone of providing a conduit for the water and then expecting that beneficent flood to flow on through stone-hewn arteries for generations to come without further consideration.

Power plant of the Hudson River siphon
Note the reel of cable supplying energy for the pumps and lights carried by the boat

As a matter of fact the aqueduct must be available for inspection throughout every part of it and this is the engineer's defense against deterioration breakdown and the menace to health if not the denial of sufficient water to the ceaselessly increasing millions of the nation's Metropolis. So, too, from time to time various sections of the aqueduct must be subjected to one test or another, and these should properly simulate the circumstances or stresses of maximum service. Because of these requirements it will be necessary at intervals to unwater or drain great stretches of the aqueduct and to withdraw from its tunnels and shafts and pipe lines millions upon millions of gallons of water, and to do this with all reasonable dispatch.

The engineers of the Board of Water Supply of the city of New York have made preparation for just such contingencies, and the drainage equipment for the Rondout pressure tunnel and the Hudson River siphon are distinctly unique. They are this because of the conditions imposed and the facilities devised to meet successfully these unusual circumstances. The Rondout pressure tunnel contains 30 000 000 gallons of water and to drain that portion of the aqueduct the greater part of that water must be lifted 500 feet! Again in dealing with the Hudson River siphon the pumping out in that case finally imposes the unparalleled task of raising the water from a depth of 1 114 feet below tide level. It called for some study upon the part of Mr J Waldo Smith the Chief Engineer and his able associates before the plan ultimately adopted was decided upon.

There were many different schemes suggested and these eventually narrowed down to the following:

(1) Use of compressed air
(2) Automatic bailing device, such as commonly used in mines
(3) Artesian well pumps in separate shafts
(4) Mine sinking pumps
(5) Pumping equipment to be located on a float and follow the water down

Of these the last method was chosen because it promised to be the most suitable for the problem both on account of the minimum amount of machinery needed and the cost of masonry work involved. The drainage shaft in the case of the Hudson River siphon is the exploratory shaft on the east side of the river which was originally driven in order to determine how deep it would be necessary to go in order to get thoroughly sound rock for the tunnel running from shore to shore beneath the river. This shaft really forms an integral part in the water supply system. At a depth of 192 feet below tide level there is a connecting tunnel reaching back into the mountain for 800 feet and there linked up with the aqueduct extending southward to the city.

The pumping boat at the bottom of the drainage shaft of the Hudson River siphon. It carries four two-stage vertical centrifugal pumps

The gooseneck secured to the drainage pipe leading up from the boat in the shaft. Note the crane and counterweight of the gooseneck

Ordinarily this shaft on the eastern shore of the Hudson is entirely filled with water, and the top of it is under a "head" of a little over 400 feet, because of the height of the water in the aqueduct passing through the mountains east and west of the river. Therefore, it is necessary to cap and seal this shaft by a huge dome of steel cast in one piece. This is removed when the shaft is to be drained. But before this is done the water in the system above this point is allowed to escape through blow-outs until the level is brought down to that of the tide. Then something like 40 000 000 gallons remain to be pumped out in order to drain the siphon and the tributary parts of the aqueduct lying below the tide level. The drainage shaft has a diameter of 14 feet. In a chamber just above tide level is stored a cylindrical boat or float. This carries the pumping outfit. It is 12 feet 9 inches in diameter with a total depth of 30 feet and when bearing its final load will have a freeboard of a little short of 2½ feet above the surface of the water.

Within this boat is installed the electric pumping plant with a capacity of something like 5 500 000 gallons daily. It contains two 4-stage vertical centrifugal pumps each provided with a direct connected electric motor. These pumps discharge into a 10 inch pipe which rises vertically from the center of the boat. The discharge pipe is connected by means of a special gooseneck pipe to a small chamber from which the water flows away into a nearby stream or sewer. The manner of operating the pumps and arranging the exhaust conduit is interesting. When everything is ready and the operator or operators in charge of the boat are at their stations the pumps are started and at once they begin the task of removing the water beneath the boat and thus promoting its gradual descent into the shaft.

In this fashion the water is lowered about 20 feet. Then the discharge pipe is disconnected from the gooseneck pipe which has followed it down and another 20-foot length of discharge pipe is interposed in the line the gooseneck joined to the upper end of the new section and pumping resumed. Again when the boat has gone down a score more feet then the joint with the gooseneck is broken and an additional link in the discharge pipe inserted. The making and breaking of the joints is effected quickly, and the pumping operations are continued day and night until the water is removed in this way from the shafts and tunnels.

One of our illustrations shows the pumping equipment at the bottom of the Hudson River shaft nearly 1 100 feet below the top of the chamber and supporting the pipe column which is absolutely watertight. In working against this great head the pumps have been operated in series after reaching a depth of 650 feet, i e one pump exhausts into the other and by this step-up process the water is finally raised to the ground level. Some idea of the service required can be gathered from the fact that the discharge end of one of the pumps reaches a pressure of about 525 pounds to the square inch. To prevent excessive leakage due to this high pressure the engineers of the Water Supply Board were obliged to devise a special form of metal packing for the stuffing boxes on the shafts of the pumps. Nothing suitable for the work was available in the market.

The power for the electric pumps and the current for the electric lights attached to the boat are supplied by means of a heavy cable fed from a reel at the top of the shaft and as the boat descends the reel pays out the necessary length of cable. The man or men aboard the boat are able to communicate by telephone at all times with the people above and this circuit is maintained by a separate cable payed out in unison with the heavier one. The shaft is ventilated by forced draught—the air being led down by a canvas conduit but the circulation is further stimulated by the heat given off by the pump motors. This induces convection and stimulates the downward passage of fresh air from the surface. Just before the boat reaches the bottom of the shaft and settles into the sump or recess provided for it it has to float the accumulated weight of the entire length of the discharge pipe. It is for this reason that the boat used in this part of the aqueduct has a greater displacement than that used for similar service in the Rondout section.

The boat is steadied vertically by means of concrete guides formed upon the surface of the shaft. This prevents any rotary motion. The boat with its equipment can be brought to the surface again when the siphon is refilled or it can be hoisted out. When this is done the equipment is dismantled at the bottom of the shaft and raised piece by piece. The final step consists in bringing up the float itself which weighs about 14 tons. The pumping machinery can be used elsewhere and is designed to be taken from place to place and reinstalled in other floats for the same service.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns especially when such articles are accompanied by photographs

The Problem of Mexico

THE drift of events during the past few years, and particularly during the past few weeks, has forced the conviction that some day, sooner or later and rather sooner than later, the United States will be driven to the necessity of bringing order out of the universal chaos which prevails in Mexico, and in this connection we direct special attention to the article in the present issue on that country, written by one who has made a special study of the complicated problems of that sorely distracted land.

The fact that the author of the article is a military man lends particular significance to his conviction that the restoration of Mexico is as much, if not more, a question of civil reform than of military force As a matter of fact it calls for the exercise of both, military force being employed only in such sufficiency as would provide for the introduction and permanent operation of civil reforms.

It has been predicted that the complete conquest of Mexico would need the employment of five hundred thousand troops Probably it would take that number to Belgiumize Mexico, but the United States has neither the heart nor the wish, nor the peculiar form of genius for a task of that kind When we take hold of the Mexican problem with a firm hand and a definite purpose, we must act in the same spirit in which we entered Cuba and the Philippines. Our policy and its results in those once unhappy islands are of record. The motives were humanitarian, and the splendid results, as given in the article above referred to, stand as a proof of our altruistic attitude to the Philippine people.

All humanity is actuated by the same basic impulses, and of all the emotions the love of offspring is the strongest and most nearly universal Hence the security of the home is the only assured foundation of government Our success in the Philippines was directly due to the recognition of these fundamental conditions by those who had charge of our affairs out there It took but a few years for the United States government to bring peace after a long period of alien domination Compare this with the situation in Formosa, where the natives are still resisting Japan after all her long years of occupation Our success in the pacification of the Philippines constitutes a high tribute to the character and ability of our officials The dishonest white found himself in Bilibed prison as quickly as did the dishonest native, the self seeking American office holder was soon given his papers, the inefficients were sidetracked The insular government, acting as would a great sieve continually shaken with violence, retained only the men of large caliber and broad outlook, a few years of that strenuous administration left only the big men in office The Philippine occupation forms one of the brightest chapters in the history of our civil and military administration There was evidence of unselfish devotion to a high ideal—as witness the case of one Governor General who turned his salary back into public works. It is a fact that, in all our years of occupation, not a single American official down there has accumulated even a small competence

Our record in the Philippines stands as a proof of our good faith, which we commend to the consideration of the Mexicans and the smaller American republics.

Should the course of events (or Destiny if you will) necessitate our pacification of Mexico, we have not only the power to take over and administer the country but we have the men all well known, most of them available, and few of whom would not be willing to undertake any personal sacrifice if called upon by the President There are men who have lived for years among Spanish speaking and Spanish thinking people; men who have made the trial, partially failed, profited by their failures and tried again. Should we undertake such a limited military occupation as is suggested elsewhere in this issue, there is not a branch of the government which these men, rich in their Philippine experience, could not direct with a minimum of friction and administer with supreme honesty and with a single eye to the ultimate benefit of Mexico

A Federalization that Would Be Fatal

THE Hay bill and the Chamberlain bill have been passed respectively by the House and the Senate In the Senate, where the present diplomatic controversy with Germany undoubtedly had its effect, the Chamberlain bill was carried with scarcely a dozen Senators opposed to it, and it went through without a roll call This bill authorizes a regular army of 250,000 men as against the 140,000 provided in the Hay bill 261 000 volunteers, and 275,000 state militia subject to federal call The bill also provides a system of military training for students in schools and colleges, application for the training to be purely voluntary, with the understanding that all students over eighteen years of age by volunteering, obligate themselves to answer any federal call to the colors which may be issued by the President during their training period

We should feel more inclined to congratulate the Senate on the passage of this bill, were it not that it contains the same serious defect that mars the Hay bill, as passed by the House In both cases, the so-called federalization of the militia, which includes among other provisions the payment of that body, is distinctly unconstitutional The Judge Advocate General of the army has given it as his opinion that disobedience on the part of a member of such a federalized militia would not constitute an act for which the man could be tried by federal court martial, and this because of the inevitable clash between the proposed federal and the existing state authority

Under the suggested arrangement the amount appropriated annually for the militia would have to be increased from the present sum of $6,000,000 to a total for the proposed militia of 275,000 of $75 000 000 Now $75,000,000 would build, equip and maintain three battle-cruisers a year, and we ask those members of the Senate who have voted for this section of the bill, whether a steady addition of three battle-cruisers a year to our fleet would not be a far more powerful deterrent to any possible enemy than the existence of a body of what any European army would call comparatively raw and untrained troops, for such the militia always has been and in the very nature of things must ever be. Let us, for example, take the case of Germany, whose troops undergo two years of continuous intensive training To her military mind our militia, who receive only forty-eight drills at night in armories and not to exceed ten days a year in camp, are not trained soldiers and under existing conditions never can be regarded as first line effectives. This is not the fault of the militia, but of the system upon which it has been planned and under which it exists We have the greatest regard for the militiaman as such, and if he is not as he cannot in the nature of things be a first-class soldier, since he lacks the soldier's training and experience, it is not the militia man's fault

In the present defenseless condition of the country every dollar that is spent for defense should be spent to the best possible advantage Our national history has proved that the militia, as at present organized, is a force of doubtful utility, and to spend an additional $75,000,000 a year upon an experiment which has proved to be a failure is the supremest folly Furthermore, as we noted in our issue of April 15, throughout all this attempted army legislation there has been maintained a powerful lobby of militiamen in Washington. Hence the House and the Senate now stand committed to a paid militia with all the political abuses which will inevitably arise, should this element in the bills be jammed through the House and Senate Conference Committee The military propaganda in Washington, emboldened by its success, would now seek to consolidate itself preparatory to a fresh advance This has ever been the history of pernicious political movements of this character We repeat that, unless the country wakes up to the sinister meaning of what has happened, representative government itself will be threatened, and the only militarism which we have to fear, namely, a military force using political influence to gain for its members special consideration under the laws, will not only be found in our midst, but will soon set itself to the task of becoming the dominant political power

Universal Time

HAVING annihilated space by means of the electric telegraph, man found himself face to face with a daily and hourly paradox. A cablegram leaves England at noon, and in the proverbial "twinkling of an eye" arrives at its destination in India. The Indian operator looks at the clock Does it mark the noon hour? Not at all. Notwithstanding practically instantaneous transmission, the despatch does not reach India until 5.30 P M. Even more curious is the result of telegraphing in the opposite direction. A message is wired from Greenwich at noon and it reaches New York at seven o'clock in the morning of the same day—five hours earlier than it was sent!

These statements involve contradictions in terms with which we have become so familiar that they have lost their *strangeness. Nevertheless the contradictions* remain When it is *now* in London it is neither more nor less than now in Calcutta and New York Call it what you like the time remains identical. But why this bewildering diversity of "times," when there is really only one time?

The answer is easy We have inherited from our remote ancestors their primitive conceptions of the time o' day, just as we have inherited many other primitive conceptions which, but for the mental inertia of our species, would have passed into oblivion long ago Early man found himself provided with a ready made timepiece in the shape of the sun. Sunrise, high noon and sunset were the events that marked off the progress of the day The daylight period, or "natural day," which circumscribed most human activities, was the all important time-interval Even when the ancients divided their day into hours, it was the natural and not the civil day that was so divided In Greece and Rome there were 12 hours between sunrise and sunset —hours that were long in summer and short in winter The advantages of using hours of uniform length were so little appreciated, that the more elaborate forms of water-clock, or clepsydra, were with great ingenuity, constructed so as to vary their pace with the season, an expedient comparable in its naiveté with the attempts made in comparatively modern times to construct mechanical clocks that should take account of the equation of time and keep pace with the sun-dial One can imagine the perplexity in which an ancient Greek or Roman horologist would have found himself involved if he had traveled to circumpolar latitudes, where the "natural" day, at its maximum, lasts for weeks or months, and each of its hours" (according to the classical conception of this time unit) would be several modern days in length

But only the astronomer and the mariner have completely broken away from the parochial time-keeping system of antiquity, and then only for certain purposes. Greenwich time prevails in the observatory, but must frequently be translated into local time Ships' chronometers keep Greenwich time, but ships' bells a makeshift local time.

The idea of making Greenwich mean time universal is not a new one When standard time was adopted in America there were many advocates of the plan of using one kind of time instead of five The International Time Conference which met in Paris in 1912 declared that ' the universal time shall be that of Greenwich," and the wireless time signals of the world are now based upon this decision.

One might hazard the prediction that the day will come when only one kind of *standard* time will be used throughout the world—viz., that of the meridian of Greenwich—but this does not mean that we can do without local time Probably the present system of time zones with their very irregular boundaries (determined in America by the exigencies of the railways and in Europe by political frontiers), could be abandoned altogether The clocks in railway stations and telegraph offices might keep identical time in England, India, China and America. The curious fiction of the International Date Line could be given up We might even apply the nomenclature of the Greenwich clock to our office hours and our meal hours. It would, at first, seem strange to the New Yorker to begin work at 4 A M instead of 9 A M, and dine at 2 P M instead of 7 P M, but as these changes would be merely nominal and involve no dislocation of his habits with respect to daylight and darkness, he would soon become accustomed to them.

On the other hand there are certain purposes for which it is essential that the record of time shall furnish some indication of the local hour angle of the sun. Suppose, for example, it is a question of drawing a curve to show the daily march of temperature. The time coördinates of such a curve would be meaningless for both practical and scientific purposes if labeled in Greenwich hours, unless, of course, the place to which the data referred happened to lie on the meridian of Greenwich It should be noted that the standard time now in vogue is also, though in a less degree, inappropriate for such uses, except in reference to events that occur on one of the standard meridians. Indeed, for refined observations we need not only local time, but "apparent" (or sundial) time.

Two corollaries suggest themselves. First, universal time has no use for "A.M." and "P.M" The hours should be numbered from 1 to 24 (as they are already in many countries) Second, the phraseology employed in naming the time of day should indicate whether universal or local time is meant by some briefer method than is now available.

Automobile Notes

"Fat Sparks"—A great deal is written about the efficacy of a "big, hot spark" in producing increased motor efficiency and speed, but reduced to actual facts the increasingly hot spark from a magneto, resulting from higher motor speed, is only of advantage in as far as it tends to clear the soot from the plugs This hotter spark is the result of higher motor speed, and not the cause

Simplified Lubrication—In view of comments recently made in this column in regard to the innumerable little spots around controlling levers, brake rigging, etc., which ordinarily depend for their lubrication on a varied assortment of oil and grease cups, carefully tucked away in unsuspected corners where many of them are never found after the machine leaves the shop it is interesting to note that an oil less bearing has been developed which, it is claimed, takes care of these small, but important points, and relieves the owner of much trouble and worry

A Suggestion in Preparedness.—In the discussions about preparedness it has been prominently suggested that a belt line road be built around the United States, near the sea coast Such a road would be of undoubted value, but enthusiasts in this direction apparently lose sight of the fundamental fact that either for war or peace, we need good roads everywhere Another lesson that can be drawn from the experience of Europe of late is to so build the roads that they will stand up in time of need If our special war roads were built by the average county official they would probably not survive actual war conditions over a week.

Motor Vehicles in War—It has been quite generally recognized that France was saved, in the early days of the war, by the aid of motor vehicles, which enabled rapid mobilization of troops and supplies to be effected, and since that time, in this mechanical war the uses, and the necessity for motor vehicles have grown to such an extent that it is fully recognized that the army that is best supplied with transportation facilities both for men and supplies, easily dominates one of equal strength that is not so equipped It is humiliating that our government is so oblivious to the world's progress, but some of our motor associations and our National Guards in some states, are agitating the matter of organizing military motor transportation squadrons for the purpose of study and experiment.

40-Cent Gasoline—It is freely predicted, and with every possibility of coming true, that the price of gasoline will go to 40 cents within a short time, and this can hardly be regarded as less than a catastrophe, especially at this time when business men are just beginning to appreciate the value of motor trucks for commercial purposes. This situation raises a point on which makers of motor vehicles have been noticeably silent, and that is the use of heavier fuels, which seems to be vastly more important than some of the improvements that have been occupying attention of late An engine operating on distillate, kerosene or some other cheap fuel would be the salvation of the commercial vehicle business, and would appear to be absolutely vital where the much talked of farm tractors are concerned

A Divided Exhaust Manifold—What appears to be an excellent idea is the divided exhaust manifold that has been adopted by one manufacturer It has been more than suspected that the ordinary type of exhaust manifold is not conducive to a free escape of the gases as the violent discharge of cylinder nearest the outlet of the manifold is likely to back up the previously discharged gases from cylinders nearer the dead end of the manifold In the design in question which is for a four-cylinder engine, the manifold is composed of two separate passages contained in a single casting, which combine in a single outlet. Cylinders 1 and 4 connect with one of these passages, and cylinders 3 and 2 with the other, which would appear to give the gases an ample opportunity to establish a flow in the right direction before they are broken up by an opposing discharge.

Ignorant Drivers.—The number of furiously steaming radiators to be noticed, even on the coldest days, calls attention to the fact that the average driver of a motor vehicle has very vague ideas about operating his engine—and this is only one point in which he is lacking The prevailing error seems to be in running with full throttle and retarded spark, a sure method of overheating the engine, and one which would soon result in disaster if the cooling apparatus was not extremely efficient. Even as it is such practice does the engine no good. When speed is to be reduced the first operation is to check the throttle until there are signs of knocking, when the spark may be gradually retarded; and when increasing speed the operation is reversed, the spark being first advanced, followed by opening the throttle. Many a lowly motorcyclist, with his air cooled motor, could give points to the superior automobilist on efficient and economical driving

Science

The Gilbert and Ellice Islands, in the Pacific Ocean which were proclaimed a British protectorate in 1892, have now been annexed to the British Empire as a crown colony The population of these islands was reported in 1911 to be 26,417 natives and 446 foreigners.

The Ecological Society of America, which was organized at the time of the Columbus meeting of the American Association for the Advancement of Science last December has already enrolled more than 200 members Dr Victor E Shelford, of the University of Illinois is president, Prof W M Wheeler, of Harvard University, vice-president and Dr Forrest Shreve, of the Carnegie Desert Laboratory, Tucson, Ariz., secretary treasurer The society will hold an annual meeting for the reading of papers, and will also organize field meetings from time to time in various parts of the country During the present year field meetings will be held in the neighborhood of Chicago in June and at San Diego in August

War Changes in Geographic Names—It is announced in *La Geographie* that the French admiralty has replaced the numerous German geographic names in the French subantarctic island of Kerguelen by names of French origin We join heartily in the wish expressed by our British contemporary *Nature* that similar practices may not be carried too far Any change of this sort is a potential cause of confusion, not to mention the expense entailed upon the publishers of geographical and other reference books We have already noted in these columns several previous changes in names due to the war In this connection it is interesting to record that German writers and publishers have almost unanimously ignored the change in the name of the Russian capital to "Petrograd"

The Dangers of Wood Alcohol are just now attracting much attention, not only on the part of the public but also, fortunately, of legislative bodies A note in *Public Health Reports* records the progress of the campaign against this substance during the year 1915 The National Association of Retail Druggists adopted a resolution opposing "the use of wood alcohol in medicinal preparations to be used by human beings," and in favor of such labeling as would protect the public against its harmful use Two states, New Hampshire and South Dakota, each enacted a law restricting the sale of wood alcohol and prescribing a form of label to be used. The South Dakota law debars its use in any food, drink, medicine or toilet preparation intended for human use, internally or externally The cities of New York, Chicago and Montclair N J, have adopted regulations or ordinances restricting its use

Zoological Station in British Guiana—A new undertaking of the New York Zoölogical Society is the establishment of a tropical station in British Guiana, for the study of the evolution and life histories of the local fauna especially birds Funds for the first year's work of the station were furnished by Messrs Cleveland H Dodge Mortimer L Schiff C Ledyard Blair James J Hill and George J Gould, while the government of British Guiana has offered the use of its botanical gardens and wild government land The officers of the new station, who sailed from New York January 22d comprise C William Beebe curator of birds in the New York Zoölogical Park in charge, C Inness Hartley P G Howes and Donald Carter It is proposed to build a bungalow at the edge of the jungle and equip it as a laboratory One of the first birds to be studied will be the hoazin (*Opisthocomus cristatus*), of which there are no specimens in captivity and concerning which there has been much controversy One function of the station will be to collect and forward regular supplies of living animals for the New York "Zoo"

The Growing Love of Wild Birds among the people of this country is commented upon in the last annual report of the U S Biological Survey Everywhere efforts are being made to increase the number of birds and attract them to the vicinity of homes This movement is said to be partly æsthetic, but also partly due to a growing appreciation of the usefulness of birds as insect destroyers. The report declares that "the increase of interest in wild birds throughout the United States during the past decade has been phenomenal, and organizations having for their chief object the care and protection of birds are numbered by hundreds, if not thousands" Efforts to attract birds to city parks and suburbs have been made by many civic leagues and women's clubs In order to aid this interesting movement the Department of Agriculture issued last year two publications, entitled "Bird Houses and How to Build Them" and "How to Attract Birds in the Northeastern United States." The latter is the first of a series planned to cover all parts of the country These publications devote special attention to the kinds of fruit bearing shrubs and trees that are important as furnishing food for birds.

Aeronautics

An Aerial Ambulance, it is reported, is being built by a California manufacturer and army aviators at San Diego Cal, have been permitted to see it Under the body of the aeroplane is slung a small cot, which is so fastened and constructed that it will be impossible for the occupant to fall out or even be shaken when the aeroplane volplanes to earth It is understood that while the craft is en route to the hospital a trained attendant will be enabled to give first aid to the patient

A German Anti-Aircraft Gun—The Germans are using at the present time a 104 mm anti aircraft Krupp gun 45 calibers long which sends a projectile weighing 15½ kilogrammes with a muzzle velocity of 800 meters to a height of 4000 meters It can be fired at the rate of 15 rounds per minute The shrapnel shell which it fires is said to burst into 625 fragments Guns of this type as well as those of 120 mm are the ordnance which defends Ostend

German Aviatik of New Type—A new type of Aviatik biplane was recently brought down behind the French lines Its wings which no longer sweep back as in the earlier types measure 41 feet in span with a chord of 6.4 feet. The structure is of oval steel tubing throughout The engine is a 170 horse power Mercedes driving a Garuda tractor The weight, empty works out at 1 600 pounds and the useful load including armament amounts to approximately 1,300 pounds The machine is exceptionally fast and has a climbing speed of 4 000 to 4 500 feet in fifteen minutes.

Fifteen-Ton Flying Boats for British Admiralty—The British Admiralty has ordered 20 triplanes similar to the 15 ton Curtis flying yacht which is now being completed at a plant near Buffalo according to a recent statement of Henry Woodhouse, governor of the Aero Club of America The spread of the planes of these machines will be 133 feet and the propulsion will be supplied by four 12-cylinder 250 horse-power motors An auxiliary motor will be provided to drive a screw propeller so that the craft can be navigated at slow speeds on the surface of the water

Transatlantic Flight by Aeroplane—It is reported that Rodman Wanamaker is preparing again for a flight across the Atlantic Ocean in an aeroplane A machine for the purpose is now building It is said to be a giant triplane of larger proportions than anything hitherto attempted mounting motors capable of developing 1 800 horse power The present understanding is that the flight is contemplated for the early part of the coming summer and that the pilot for the trip has not yet been decided upon The course too, is still undecided although it will probably be laid from St. Johns N F The fact that details concerning both the aircraft being built and the contemplated journey are being withheld from the public renders impossible any comment on the undertaking for the present at least

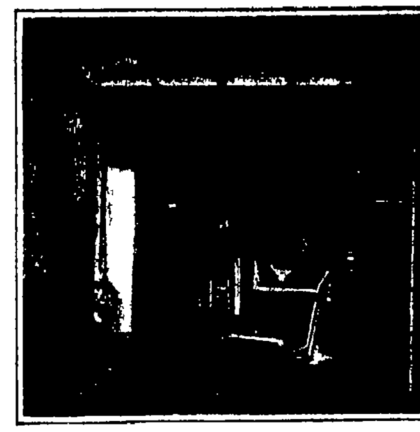
The Causes of British Casualties among aviators was a topic of keen discussion in the House of Commons recently Noel Pemberton Billing, lately elected on the air preparedness issue stated that a series of casualties with a total of 150 dead 150 wounded and 105 missing was due to the sending of British aviators to the front in aeroplanes which were outclassed hopelessly by German machines Harold J Tennant Parliamentary Secretary of the War Office made conciliatory answers to these charges and assured Mr Pemberton Billing that he was wholly misinformed, although admitting that at present a majority of German machines were probably faster than the bulk of the British machines He added however that the disadvantage was only a temporary one and the near future would witness the British aviators on superior mounts.

Heart Action at Great Altitudes—Dr G Ferry, a Frenchman enjoying the rank of *Aide Major de 2e classe au Parc d Aviation* brings forth some interesting facts regarding blood pressure at various heights in a recent issue of *La Presse Medical* which are based on careful records made during a number of flights His conclusions are The pulse becomes more and more rapid from the ground up to a height of 750 meters From this height to 1 250 meters it still augments, but less rapidly Above this height it again accelerates more rapidly The period of slower acceleration seems to be explained by the fact that between 750 meters and 1 250 meters the air is usually calmer than at lower altitudes and the wind more regular Above this height the cold becomes a great factor in acceleration Each time a gust strikes the aeroplane the pulse accelerates. During a flight at a particular altitude the pulse remains constant When descent begins there is again for a very short period a quickening of the pulse, due it is thought to the thrill of excitement experienced when the engine is shut off After this the frequency falls in a regular manner during a slow descent. Each event in the descent causes an acceleration, short, but definite The pulse at the end of the flight is always more rapid than at the beginning

Automobile Dental Shop of the French Army

By Jacques Boyer

Traveling dental shop now in use in the French army



Interior view of the French automobile dental shop

SINCE meat is the predominating food of troops in active campaign according to French practice the soldiers must possess either good teeth or artificial ones in the proper condition to permit of the thorough mastication of food. It is accordingly necessary to provide dental specialists at the front who are capable of attending to the teeth of the soldiers in order that the numerous ailments arising from defective teeth may be avoided for they lessen the soldiers efficiency.

There is in operation a dental service situated a considerable distance in the rear of each army corps on the French front usually 30 to 40 kilometers distant from the first line trenches. But the main difficulty in connection with the existing service is that the men on active duty find it seldom possible to travel back to the dental stations. More often, dental troubles are attended to by the men themselves or by doctors who use a pair of forceps to extract troublesome teeth for want of dental knowledge and equipment. Obviously such a radical procedure is incorrect and unfair to the men; hence there has long been a need for a traveling dental shop provided with all the necessary equipment and a skilled personnel following the regiments on the march and at all times situated as close to the front as possible.

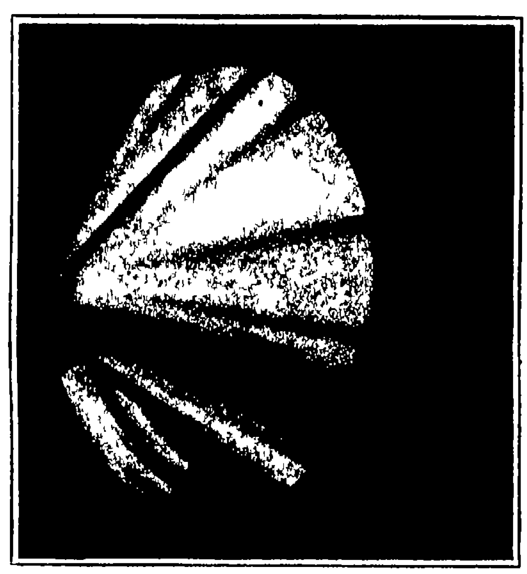
There has recently been devised by Doctor M. Gaumerais, attached to the complementary hospital 81 of the French army in the capacity of adjutant, an automobile dental shop which solves the problem of giving proper attention to the dental ailments of the soldiers. The shop is known as the *voiture de stomatologie* and is installed in an automobile bus of a standard model used in the French army. The interior is of sufficient height to permit the men to stand erect. About two thirds of the depth on one side is occupied by a cabinet containing all the necessary dental supplies and instruments and the remaining space is devoted to the dental laboratory or workshop where the mechanical work of dentistry is accomplished. In the former portion of the traveling dental shop is also included a standard chair mounted on a platform provided with castors so that it can be moved about.

The rear end of the traveling dental office consists of an upper and lower half both of which are hinged. While traveling the two halves are closed. When the shop reaches its destination the two halves are opened; the upper one forms a roof and is equipped with glass windows which act as a skylight while the lower one supported by side chains and iron rods reaching to the ground provides additional floor space. It will be noted in the illustrations that this feature causes considerable space to be added to the dental shop when the automobile is at rest, and that the extended portion can if desired, be inclosed by using canvas curtains. It is in this extended portion that the movable dental chair is brought where the dentist will have plenty of light to aid him in his work on the patient. The accompanying illustration showing the interior view of the traveling dental office does not fail to disclose the complete ness of the equipment.

According to official reports the rolling dental shop was used for 1,800 dental operations of different kinds during the month of October, 1915, not including 63 cases of purely mechanical dentistry. Unfortunately the personnel of the shop only includes Dr. Gaumerais aided by a dentist and a mechanical dentist; hence the utility of the shop is limited in its scope. It would be necessary to multiply the number of automobile dental offices so that each unit could be devoted to four army corps in order to render the proper dental care to all those in need of it.

A Detachable Headlight Dimmer of Novel Design

HEADLIGHT dimmers in almost endless variety are not lacking in these days of strict municipal ordinances but it is doubtful if any are more novel than that recently introduced by an American manufacturer. The new dimmer is made of pyraline—a strong flexible and transparent material—with an expansible material that fits snugly over the outside rim of the headlight which holds the dimmer in place irrespective of weather conditions. The dimmer is provided with a seam through the center which permits it to be collapsed when not in use. When fitted over a headlight, it permits the uninterrupted projection of the rays of the lamp through an opening at the bottom but diffuses such rays as would ordinarily blind the drivers of vehicles moving in the opposite direction.



A headlight dimmer that may be readily attached and removed at will

An Apartment That Travels on Wheels

WHILE it is true that in numbers the automobile camping outfits which have made their appearance in the recent past have not been lacking it can likewise be said that no great degree of originality has been displayed except in a few isolated instances. For the most part the motor car camping equipments have been crude and distinctly of the home-made variety. It is for this reason that the so-called "automobile telescope apartment" recently introduced by an American inventor commands interest.

The automobile telescope apartment can be attached and detached from any light automobile chassis in 15 minutes, according to the claims of the designer. Its total weight is only 175 pounds. As will be noticed in the accompanying illustrations, while on the road the equipment is entirely inclosed in a box-like body, which is mounted over the portion of the chassis ordinarily occupied by the tonneau, or, in the instance of a runabout or racing model the portion devoted to the sloping rear body or large gasoline tank. On the other hand when at rest the furniture of the transportable apartment is spread out. It includes a comfortable folding table, provided with two folding chairs, an oil stove and kitchen closet replete with pots, pans and other utensils, as well as table ware, a closed bed which will readily accommodate two persons, and a number of drawers for clothing and other articles, as well as storage space for baggage. So compactly does the equipment fit into the box-like body that at first glance one is apt to be incredulous as to whether all the articles have been transported by the automobile. Yet a study of the illustrations reveals how ingeniously the designer has fitted the different parts of the equipment into the body.

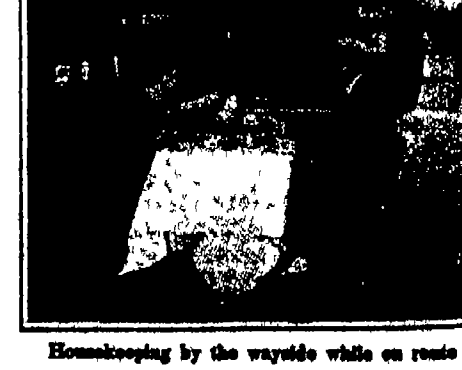
The traveling apartment is said to be excellent for light housekeeping while on a lengthy tour. Electric lights placed over the kitchen section and over the dining table add the final touch of refinement to the profuse equipment.

The Current Supplement

THE glaciers that exist in various parts of the North American continent are unsurpassed in size, picturesqueness or general interest. Some of them are described in *Some American Glaciers* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No. 2104 of April 29, and it is accompanied by a number of excellent illustrations. The second article on *Economy in Study* appears in this issue, the subject of this instalment being *Educative Imagination*. *Field Cables* describes and illustrates how telegraph lines for maintaining communication between headquarters and the various divisions of an army are maintained on the battle front. *Leaf Photography* tells of peculiar chemical characteristics of the leaves of plants, and illustrates some interesting experiments that may easily be made. *Lutes and Cements* gives the formulæ for a number of compounds that will be found of great value to the chemist and the physicist in their every-day laboratory work, and to the investigator generally. *Electric Cooking Ranges in Hospitals* describes and illustrates a simply operated equipment used where a large number of people must be fed promptly, economically and with a minimum of labor. *Farm Tractors* briefly reviews the history, conditions of use and methods of construction of a power implement that must prove of vast value to the farmer. *Mica* summarizes much information relating to an interesting and widely useful mineral. *The Blind Spot* describes a peculiarity of the eye that is a source of danger and which might explain the cause of many accidents, both of automobiles and railroads. Other articles of value include *Notes on the Eucalyptus Oil Industry in California*, *Annealing Furnaces* and *Dangers of Rubber Manufacture*.

Automobile telescope apartment on the road

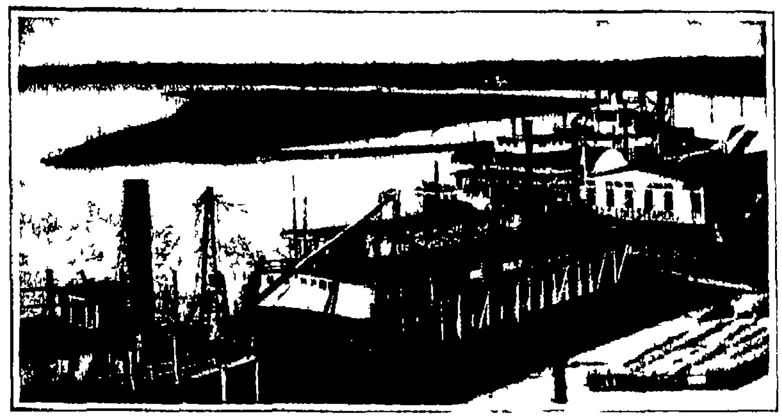
Side view of the automobile apartment, showing the kitchen



Housekeeping by the wayside while en route

An Island of Mud that Threatens Memphis Harbor

THE accompanying illustration shows the mud bar formed in the Memphis harbor by a whim of the erratic Mississippi, an obstruction now occupying what had formerly been a deep water channel entering one of the most accessible harbors along that entire waterway. The bar, called the "mud isle" by rivermen, is now estimated to contain in round numbers, 5 000 000 cubic yards of silt deposit—an accumulation of several years. When the fact is borne in mind that on October 10, 1913, it first appeared above water as a small shoal and two years later emerged as a forty acre tract, eventually joining itself to the mainland by a narrow strip, the rapidity of its formation can well be imagined.



View of Memphis harbor looking north, showing the island of mud that has recently formed

In the fall of 1910, soundings revealed the fact that a bar was forming and as early as 1912 its presence had become a menace to traffic. A survey of the island made at the time when the water gage registered a twelve foot stage, determined the length of the bar to be 2,800 feet long and 600 feet across at its widest point. These measurements were made early in November, 1915. The narrow strip of water separating it from the mainland measured 500 feet across at that stage. When the river continued to fall and the upper end of the chute pictured closed up incoming packet steamers were forced to avail themselves of the little remaining wharfage space.

With the gradual building up of a headland point a half mile above the harbor the main current of the stream was deflected towards the Arkansas shore. This is given as an explanation of the bar's formation, for the swift water, no longer following the wharf line channel, permitted an eddy to form. When this occurred mud deposits by the river became inevitable.

A plan to assure the eventual removal of the mud bar was approved and adopted by the Mississippi River Commission in recent session. The specifications call for a canal with a fifty foot base line to provide a 200-foot channel to be cut through this headland tract at an angle in line with the chute along the Memphis water front through which will be directed the waters of the Wolf and Loosa Hatchie rivers—two small tributary streams emptying into the Mississippi a short distance above the harbor. The proposed canal, instead of permitting these waters to enter the river at a point where they will be carried by the main current towards the Arkansas shore is expected to utilize their force in keeping the harbor chute free of sediment and to help in washing away the silt accumulation, by restoring a swift current to rout the eddy responsible for the mud bar.

The cost of the project determined upon is placed at $150,000, of which amount $55,000 is available. Congress will be asked to appropriate the remainder of the sum needed to complete the work, now well under way. In the meanwhile, Federal engineers are keeping dredges at work, maintaining a proper depth in the channel that remains. Recent high water stages may make this course unnecessary.

The Kaiser as a Draughtsman

WE have all of us heard about the versatility of the Kaiser—how he can draw, paint, compose an opera, give suggestions as to the design, execution and grouping of statuary, and, if occasion should require, as in the present war, can fill the position of commander-in-chief of the greatest fighting machine the world has ever seen.

The above enumeration by no means covers the field of his abilities—or shall we say his activities?—but just here and now we invite the attention of our readers to an extremely interesting reproduction of an original drawing by the Kaiser made some twenty five years ago and given by him to an American friend of his, Mr. Poultney Bigelow, who as a boy was a playmate of the young brothers William and Henry at the New Palace, Potsdam, and in later years was on terms of considerable intimacy with the Kaiser.

The original is in the collection of the Naval History Society, which for the present is housed in Aeolian Hall, 42d Street, New York, and it is by the courtesy of the secretary treasurer, Mr. Robert W. Neeser, that we are enabled to make the present reproduction in the SCIENTIFIC AMERICAN.

We are informed by Mr. Bigelow, who presented the drawing to the society, that it was made in pencil on one half of a large sheet of blotting paper which formed part of a folder pad used by the Kaiser at the palace. On the reverse of the sheet are several bow and stern views of ships, one of which is reproduced in the corner of our engraving. On the opposite half of the sheet of blotting paper are more drawings and the blotted signature of the Emperor "Wilhelm I. R." to a letter written "A Sa Majesté Le Roi D'Italie."

It should be noted that the Emperor's signature is in the bottom right hand corner of the drawing, and that it reads "Neues Palais, WR, November, 1891." The rest of the writing, in our opinion, is in another hand, for in view of the fact that the drawing is a very close approximation to the French battleship designs of the year 1891, we are satisfied that the Kaiser would never have claimed to be the original designer of the type of ship here shown.

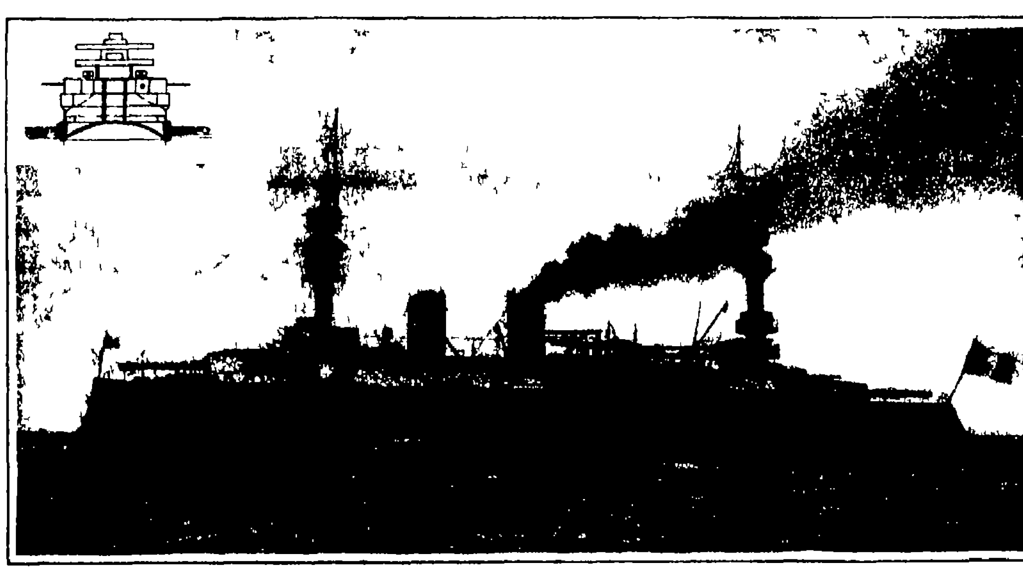
In proof of our contention we give an illustration of the French battleship "Jauguiberry," which was launched in 1893 and whose design, therefore, was probably well known to the German Intelligence Service and therefore to the Kaiser himself when this drawing was made. We draw attention to the characteristic abnormally projecting ram bow in the drawing, to the tubular military masts with their machine guns mounted in enclosed tops, to the large square portholes, to the disposition of the main battery of four guns in four turrets, one forward, one aft and one on either beam, and to the extreme tumble-home of the sides.

It is probable that the Kaiser made this rapid pencil sketch of the latest type of French battleship on his blotting pad either for his own amusement or to illustrate a description which he was giving at the time of what the French were doing.

The Naval History Society, which owns the drawing, was founded in 1909 with the object, as stated in the articles of incorporation, of discovering and procuring data, manuscripts, writings and whatever may relate to naval history, science, and art, and the surroundings and experiences of seamen in general, in general and of American seamen in particular, and to preserve the same by publication or otherwise.

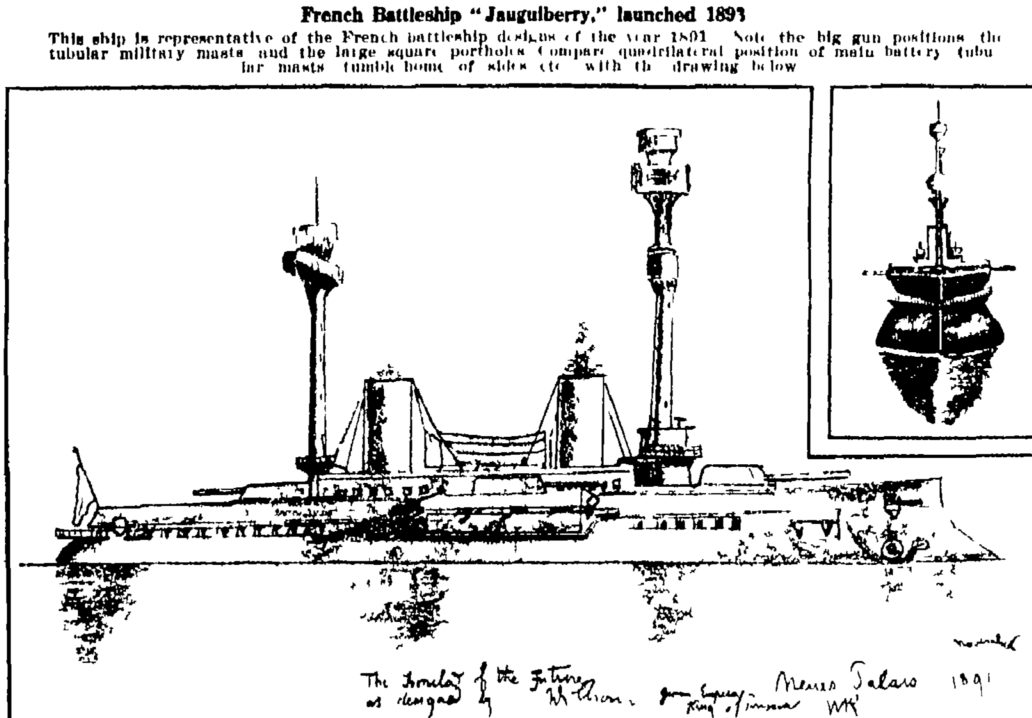
The collection, in spite of the comparative youth of the society, is already of great value and full of very strong interest, and during the present month there is an exhibition at Aeolian Hall of original manuscripts, engravings, prints and books relating to John Paul Jones. The society's collection includes the John S. Barnes Memorial Library, the papers of John Ericsson, the papers of Admiral E. Y. McCauley, U. S. N., including his journal of the Perry expedition to Japan; two volumes of transcripts from the British Admiralty in London of the Out Letters, Secret Letters, Orders and Instructions issued by the Admiralty to Admiral Thomas Graves, R. N., on the North American Station, 1781, and extracts from the logs of ships in his fleet. Among the publications of the society are the logs of the "Serapis," "Alliance," "Ariel," under the command of John Paul Jones, 1778-1780, the narrative of Nathaniel Fanning, an officer of the Revolutionary Navy, letters and papers relating to the cruises of Gustavus Conyngham, a captain of the Continental Navy, 1777-1779.

A building committee with Hon. Franklin D. Roosevelt, Assistant Secretary of the Navy, as chairman, has been formed for the purpose of erecting a suitable home for the society, and various sites in the City of Washington are at present under consideration.



French Battleship "Jauguiberry," launched 1893

This ship is representative of the French battleship designs of the year 1891. Note the big gun positions, the tubular military masts and the large square portholes. Compare quadrilateral position of main battery, tubular masts, tumble home of sides, etc., with the drawing below



Reproduction of a drawing by the Kaiser

The original (now in the collection of the Naval History Society) was made upon a sheet of blotting paper and subsequently given to an American friend

Strategic Moves of the War, April 21st, 1916

By Our Military Expert

IT is about 550 miles by land from Trebizond to Constantinople, as the crow flies, and from the character of the intervening ground that would be the least inconvenient way to get there, for marching is, to say the least, a trifle difficult.

It is unfortunate that the limited size of the SCIENTIFIC AMERICAN prohibits the publication of a detailed map which might adequately represent the difficult terrain of the Asia Minor peninsula. Practically the entire country occupied by that section of the Russian army of the Caucasus extending from Trebizond to the vicinity of Diarbekir is forbiddingly mountainous. Near Diarbekir the Russian line sags eastward through a country rimmed by mountains which look southward over the more open spaces of El Jizeirah, the section comprehended between the broad upper reaches of the Tigris and the Euphrates. Kurdistan, south of Bitlis and south of Sasun, forms a momentary flat country, over which the Russian columns are hurrying the lash to the whip.

From about fifty miles southeast of Diarbekir, the loops of the Euphrates seem to hold the mountains westward, toward the Gulf of Alexandretta, that salient of the Mediterranean which juts so sharply northward into the peninsula.

But the entire peninsula of Asia Minor is a latticework of mountain ranges, except for the comparatively small section in the center, about the Tuz Gol, the salt lake to the southward of the great loop of the Kizil Irmak River.

Roads are at a premium. The infrequency of highways with which Russia has to contend in her major operations on the main eastern line from Riga to Bessarabia, is as nothing in comparison. The country itself affords little provender to an invader. It is not profusely agricultural at best and its resources have been taxed already to supply the Teutonic allies as much as possible. This resultant barrenness has forced the Russian armies to rely almost entirely upon their lines of supply, and the difficulties of the task must be apparent to even the least studious reader.

The Grand Duke's drive is a magnificent venture, with some prospect of success—if the Central Empires can be kept busy enough elsewhere to prevent the detachment of strong forces to oppose his progress. In general, it is a drive upon Constantinople as a secondary objective to the isolation of the main Turkish possessions from the Ottoman seat of government. But for either to be successfully achieved, a flank cannot be left up in the air, and as only the southern flank is movable, insecured it must swing around from the Persian Gulf and sweep the country before it—a tremendous task. Already its extremity is southwest of Ispahan, a section is in the vicinity of the Persian Turkish border near Khanikin, a hundred miles northeast of Bagdad. And the space intervening between there and the Diarbekir sector is intervaled by columns of troops, although, apparently in comparatively slight strength, merely connecting elements.

It is not inconceivable that if the main Russian forces operating to the northward manage to extend toward Alexandretta, Entente forces may be landed at this point under the guns of their warships in the effort to effect a more speedy coupling of the line. But this cannot be done until there is ample promise of success, for the point is directly on the main line where every factor would favor the Teutonic forces. This is not a prediction by any means, it is merely the suggestion of a possibility.

It will be found when the war is over and the full story is told, that one of the masterpieces of military achievement to date is the manner in which the army of the Caucasus has been supplied with food, ammunition and equipment. When it is realized what stupendous quantities of these commodities are absolutely necessary to the very existence of an army, what a force of men is necessary to handle them, and the quantity of transportation units required to shift them, absolutely without assistance from railways in the theatre of operations, some comprehension of the feat may be had.

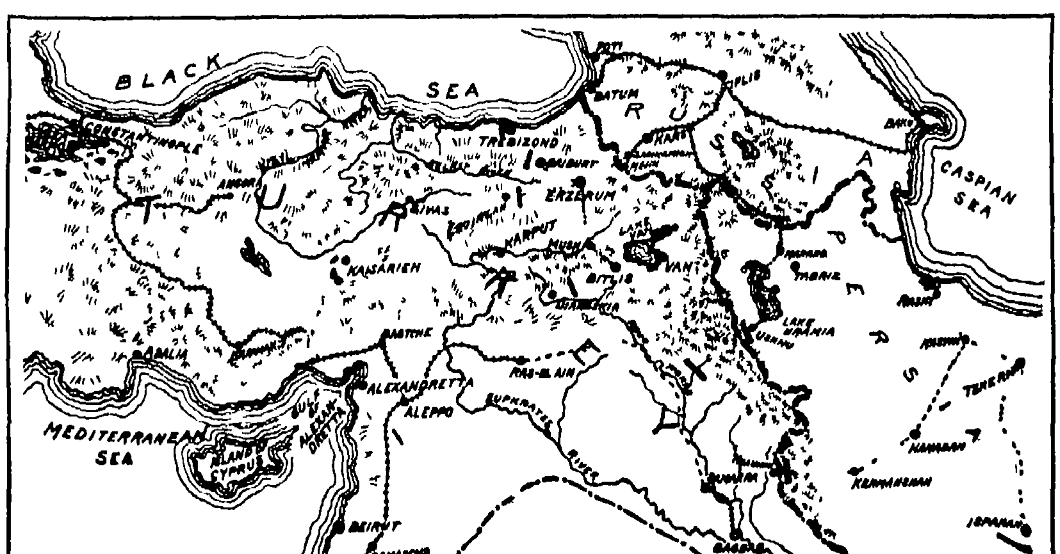
The capture of Trebizond should assist the solution of future Russian problems of transportation and supply in the vicinity, and for purposes of supply in that dreary section a vicinity may well be 150 or 200 miles. Roads and facilities are as scarce as that, for main avenues of communication.

In the earlier days of operations, the maps showed that the nearest railhead to the theatre of war was at Kars, in the southwestern corner of Trans-Caucasia, later maps, however show that the railway had been extended to Sarikamish almost on the Turkish border. This point, then, constituted the main base of operations and supply.

From Sarikamish, good (?) roads lead to Erzerum. Its fall rendered the establishment of an advanced base there feasible. From Erzerum, the line of communication extended to Baiburt, 50 miles south by east of Trebizond. Russian troops are operating in this vicinity at the present time. The line of communications to the Erzingan locality, in which Russian troops also are operating, came through Erzerum.

From Erzerum a detached base was established at Mush, which point also draws supplies over indifferent roads from lesser places. From Mush, the distribution continues in the direction of Karput and Diarbekir. Karput is close enough to the Eastern Euphrates to be served to a certain extent by that river as a line of supply, Diarbekir must rely entirely upon roads over which wheeled transportation plays.

Bitlis on Lake Van, may count to a certain extent upon Mush for a line of communications, but there is another feasible avenue which, though tortuous, extends through the Khan i Sur pass northwest of Lake Urmia, to the railroad at Marand 40 miles northwest of Tabriz. To avoid congestion of supplies and transportation, trains may be run this far on the road from Tiflis, which was projected to extend to Teheran, in Persia.



Progress of the Russian armies in Turkey and Persia

Southwest of Lake Urmia, Ushnu enjoys almost an opulence of position, for it is little more than 125 miles to Marand. Lake Urmia itself offers opportunity for forming a long link of rapid water transportation between two short hauls, at each end of the line. This place an important road junction, must supply any forces operating in its vicinity with comparative ease.

The situation in southern Persia is far more difficult. The Caspian Sea must constitute the most feasible route for the forwarding of supplies. Landed at Resht, in a wonderful protected harbor they can be forwarded by road to the valley of the Kizil Uzen River and to Manjil, thence to Kasvin which is a most important junction long since in Russian hands.

From Kasvin, Teheran is supplied, from Teheran, Ispahan. And the main avenue of advance through Persia is also based on Kasvin primarily for from it extends the road to Hamadan and Kermanshah as well as to the Khanikin Pass on the border.

Names mean little in mere black and white, but it is impossible to describe the situation otherwise. It will well pay any student of the war to obtain a large map of this section and minutely examine it. It will disclose some hint of the vastness of the problem with which the Grand Duke has wrestled, and it will then be no violation of neutrality to agree that his progress thus far has been a marvel of scientific military accomplishment.

The fall of Trebizond is of no particular moment, more than the gaining of another city and control of a little more territory. Its capture has seemed imminent for some time for, with Russian domination of the Black Sea, the assistance of the navy rendered the result comparatively certain. Reports to date fail to indicate the capture of any considerable body of Turkish troops, for though it is reported that three divisions, totaling some 50,000 men were in occupation, there is no report of their taking. With the sweep of Russian forces to the southward of Trebizond they would have been in imminent danger of isolation, and they evidently had plenty of time to retire towards the general line of defense which lies well to the westward, toward Sivas and the Irmak.

Northeast of Sivas, the Kizil Irmak River from the south, and the Kelkit River, a tributary of the Yeshid Irmak which empties into the Black Sea, form a salient eastward about 70 miles from the Sivas line. These streams promise to form a difficult line to be assaulted, for neither can be turned, as they approach each other within twenty miles at the apex of the salient. The country closely enfolding them is mountainous and forbidding, and it is unlikely that any determined stand of the Turkish forces will be met by the Russians until these promising lines are approached.

The Grand Duke has accomplished wonders from a military standpoint, but his hardest work lies before him, for the troops which oppose him are just beginning to reach their chosen country for defense, and the outcome is on the lap of the gods.

Fish and Eggs Distributed by U. S. Bureau of Fisheries

FIGURES showing the distribution work during the month of February 1916, have been made public by the United States Bureau of Fisheries. These covered the species and the total number of fish and eggs. The figures are: Black bass, 43 fingerlings, brook trout, 5,000 eggs, chinook salmon 1,802,500 eggs, 7,197,000 fry, cod, 40,248,000 fry, crappie, 2,350 fingerlings, dog salmon, 450,000 fry, flatship, 395,479,000 fry, humpback salmon, 339,000 fry, lake trout, 820,054 eggs, pollack 128,504,000 fry, rainbow trout, 573,400 eggs, 20,500 fingerlings, rock bass, 500 fingerlings, silver salmon, 196,000 eggs, 94,000 fry, sunfish, 9,325 fingerlings, warmouth bass, 150 fingerlings, yellow perch, 110 fingerlings, total to end of month, 3,402,954 eggs, 572,311,000 fry, 32,978 fingerlings.

The stations from which the distributions were made, and the species from each were: Baird and substations, chinook salmon, Baker Lake and substations, dog, humpback silver salmon, Boothbay Harbor, pollack, Central Station, humpack salmon, Clackamas and substations, chinook salmon, Cold Springs, sunfish, warmouth bass, Duluth, lake trout eggs, Erwin, rock bass, sunfish, Gloucester, cod, pollack, Green Lake, landlandlocked salmon eggs, Leadville, brook trout eggs, Manchester, rainbow trout eggs, Neosho, crappie, rainbow trout, sunfish, yellow perch, San Marcos, bass crappie, sunfish, Woods Hole, cod, flatfish, Wytheville, rainbow trout.

Scarcity of Wood Pulp in Spain

THE shortage in the supply of wood pulp for paper manufacture in Spain and the high prices now demanded for this product is causing some anxiety among paper manufacturers and publishers. The daily press will probably be obliged to reduce its consumption of paper. Attention has been given to the advisability of the government's undertaking to stimulate the cultivation of the poplar tree, the wood of which is preferred for wood pulp in Spain.

Spain imports almost all the wood pulp required for its paper industries and exports to England much of the pine grown in Galicia, which is highly resinous and not so well suited for paper manufacture as the less resinous pine of Sweden and Norway. Experiments however, are to be made to ascertain if, by extracting the resin, native Spanish pine can be used, at least as a temporary substitute. Most of the local paper mills, it is stated, can not employ rag and jute wastes, their plants being adapted to wood and chemical pulps. Nearly all the waste material such as fiber waste, rags, and bagging are exported, the United States having become, since the war, the leading customer.

Correspondence

[The editors are not responsible for statements made in the correspondence column Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired]

Denatured Alcohol as a Substitute for Gasoline

To the Editor of the SCIENTIFIC AMERICAN

I have been much interested in your recent articles on industrial preparedness, and those articles relating to the work of the U S Bureau of Commerce, but I have been more particularly interested in the statements about the petroleum industry, an industry whose product, in our present complex business life, seems to be of the very greatest industrial importance

I am more particularly impressed with an omission in the articles referred to than to anything that you have printed, an omission of the proper presentation of the facts, figures and possibilities of the denatured alcohol industry whose product must ultimately be of very great economic worth

This branch of industry has been dismissed with a few words, and, at that it received more recognition than seems to be accorded it by the current agricultural and technical press of the country

The growing scarcity measured by the demand of the lighter hydro carbons for fuel for use in internal combustion engines is being very forcibly impressed on our people by the marked increase in the price of the usual fuel, gasoline, and the daily press is filled with angry protests directed at those who produce this commodity, one very prominent automobile manufacturer being reported as enlisting his efforts and his millions to correct the tendency of this necessary motor fuel to rise to a prohibitive figure, thereby affecting the motor vehicle industry in which he is interested

In all of this outcry we see no reference to the fact that denatured alcohol may be used as a substitute for gasoline, and no reference to any possibility that the alcohol may be produced at a figure that will cause it to displace the present fuel

Our people seem to have settled down to the belief that alcohol must always remain high priced and will not likely be used as a substitute for gasoline until this latter fuel reaches a very high price, and we seem to have accepted the statement that the products from which alcohol is made have a greater value as food for man and beast, at anything under the present price of denatured alcohol

I, as a user of motor fuel, have pondered over this matter and have thought that we should adopt the plan of cultivating the sugar beet for the production of alcohol as they do in Europe, but when you consider the average American farmer, one must conclude that this crop as a source of alcohol is out of the question for the aforesaid farmer will not put the hand work into a crop that the production of the sugar beet requires

But there is a crop from which alcohol can be produced, that the average American farmer can grow according to his inclinations and traditions and that is the saccharine sorghums.

Some years ago the U S Department of Agriculture spent much money and made a very creditable effort to develop the production of sugar from sorghum, but from what I can remember, it was determined that the juice of this plant contained certain glucosids that prevented the crystallization of the saccharine matter and in the then known state of chemical knowledge, the hope of adding the production of sugar to the general agricultural industry of the country was abandoned

It seems to a layman that the production of alcohol from sorghum would be an ideally simple matter a machine of crushing rolls with a small stream of water trickling on them, a further diffusion of the crushed stocks in vats of tepid water, a maintenance of the sweetened water at the proper temperature and the addition of the proper ferment, the distillation of the liquid when the alcoholic stage is reached and the addition of the denaturing substance, a process that might be carried on by comparatively unskilled labor

I have never seen any figures on the production of alcohol from sorghum, but have been informed that an acre of sorghum will produce from 60 to 100 gallons of syrup

The American farmer will cultivate this crop because it involves no new kind of labor, no hand work until the harvest, and I am not sure that for the production of alcohol there need be very much hand work then, as the necessity for stripping the leaves very carefully, would not be present if alcohol instead of syrup were to be the product.

The farmers of this country are becoming very large users of hydro carbon fuels for power, for cooking, and for the motor vehicle of which nearly every one is an owner or prospective owner, and the more general use of farm tractors will certainly be curtailed unless a low priced fuel suited to their needs is found It is the most logical and economical proposition for the farmer to produce this fuel himself, and the successful production of sorghum grown alcohol will find each farm equipped with a large steel tank for the storage of this liquid

We have immense areas of land particularly adapted to the growth of sorghum, the great southwest, Kansas, Arkansas, Oklahoma, Texas, are states to which this crop will be better than gold mines The sorghum plant is well suited to the states named as they are sometimes subject to dry weather conditions that make the production of some other crops uncertain, but in all of the corn states and the South generally, this sorghum plant is at home and could produce immense quantities of alcohol

In our present more advanced state of chemical knowledge it may not be impossible to convert the compounds in the sorghum syrup that prevent its crystallization, by some catalytic or other chemical process as in the hydrogenation of the oils to produce the more solid fats, and thereby add sugar production to the list of products of the sorghum plant

Some of our agricultural experiment stations should this season plant small tracts of the saccharine sorghum and convert the juice into alcohol and secure data that may be useful to those who may wish to cultivate this crop for that purpose

It seems to me that there is no better way to bottle up or store away for future use the sun's rays during the superabundant season than to grow this saccharine sorghum, and I believe that when the full possibilities for the production of alcohol from this plant are properly appreciated by our people it may well justify the prediction that our present vitally important petroleum industry may in ten years from now be relegated to a position of subsidiary importance

STANLEY PIKE.

Greenfield, Ohio

Nature's Mathematics

To the Editor of the SCIENTIFIC AMERICAN

Dr Russell in his recent article, "The Heavens in April, 1916," states "Dr Lowell argues further that the canals form so remarkable a geometric network of fine, sharp straight lines that they cannot have arisen from the casual operation of natural forces but must be artificial, and the products of great engineering skill"—a statement borne out by others in regard to Dr Lowell's sensational proclamation in regard to the planet Mars

The honey bee constructs hexagonal cells in which to store honey—mathematicians agree that this is the most satisfactory arrangement where economy of space and material is the object We might cite also the definite arrangement of leaves on the stems of most plants. Granting intelligence to animals and plants such results are not due to "the casual operation of natural forces"

In the inorganic world, there is, if anything a greater number of examples of nature's mathematical ability We are told that the planets of the solar system are proportionately spaced. Is there no mathematics in the unvarying molecular composition of chemical compounds? To most men the geometry of crystallography is amazing and mystifying

Apropos of the geometry of the Martian canals—most of us have seen mud flats from which the water has all evaporated, leaving surface exposed to direct rays of the sun Mayhap we have wondered at the often perfect geometric figures formed by the mud cracks Mars is a dead parched world May we not compare it with the dried up mud flat, and the canals with the cracks?

Is it true that nature never works with mathematical economy and precision?

ROSS E BOWERS.

Erie High School, Erie, Pa

A Marked Divergence of Opinion

To the Editor of the SCIENTIFIC AMERICAN

Be so kind and discontinue my subscription As much as I like your paper I am sorry to be bound to discontinue it Why cannot at least a scientific paper of your standard remain really neutral in this sad war?

Your first two military experts were really good and up to facts, while your present one is not only deficient in history but even in geography It's disgusting to notice that even "scientific" papers should permit themselves to be blinded by prejudice to the extent of printing some of the things you did for example, that German officers should have believed that England was fighting with Germany instead of against it, and the like.

Yours truly with regret

(REV) BEDE MAYENBERGER.

Freeport Minn

To the Editor of the SCIENTIFIC AMERICAN

Enclosed my subscription for another year of the SCIENTIFIC AMERICAN I had meant to attend to this matter before, but overlooked it through carelessness You may begin with this week's issue, for the present subscription or if more convenient send the back numbers which I have missed

Let me take this opportunity to thank you for the exceptional sanity clearness and fairness of all your articles dealing with subjects related to the war, in such refreshing contrast to the almost universal biased tone revealed by other journals What I appreciate even more however are the instructive and clear visioned articles dealing with the naval and military as well as industrial preparedness of our country They should be read and taken to heart by every good citizen of the U S A

With the best wishes for success I beg to remain

Very truly yours,

EMIL J SCHMIDT

Chicago Ill

Why Does Not the Submarine Give Submarine Warnings

To the Editor of the SCIENTIFIC AMERICAN

If the sinking of merchant ships without warning continues the United States may be drawn into war

If the submarines give warning by rising to the surface they would be sunk if the warned ship happened to be armed

Some years ago there appeared in your columns an account of a submarine bell to warn ships of the presence of other ships in fog Could not this bell be used by submarines to warn merchant ships to stop and thus solve the submarine problem?

Could not wireless also be tried?

F A DE PEYSTER.

11 E 86th St, New York city

Wanted—A Substitute for Steel Poster Panels

To the Editor of the SCIENTIFIC AMERICAN

You are respectfully advised that the members of the Poster Advertising Association consume large quantities of galvanized steel in the erection of poster advertising structures throughout North America These structures are built in 25 foot panels 11 feet high, upon which are displayed posters advertising various commodities and industries The steel surface upon which the paper is posted is quite satisfactory in many respects, but the steel is very expensive and being exposed to the elements deteriorates very rapidly An ideal posting surface should be smooth and rigid and yet very light, so that the faces of the panels could be easily taken down and moved to new locations

The purpose in writing you is to call the matter to your attention and if possible to secure from you information as to where a desirable substitute for the steel panels might be secured Perhaps some of the wall board manufacturers could help in this direction, if they could render their commodity water proof so that it could be used when exposed to the elements. As there are already in the United States probably a million of these panels you can readily understand that a large market awaits a manufacturer who can fill the need.

F ALLEN FROST

Chicago Ill

German Products in American Markets After the War

To the Editor of the SCIENTIFIC AMERICAN

The idea seems to prevail that after the war the United States will be flooded with cheap German products Germany first secured a market here by selling goods made by cheap and abundant skilled labor Laborers both skilled and unskilled, are being killed in vast numbers After the war the scarcity of skilled labor and the heavy taxes which the remainder must pay will make higher wages imperative Will this not necessarily increase the price and lessen the quantity of goods for export? There will also in some quarters be a prejudice against German products which will limit the demand and importers will be slow to buy goods which they cannot sell May not these conditions prevent the anticipated flood of cheap German goods?

H N ROBINSON

Hartford Conn

Forest Wealth of Morocco

THE preservation and exploitation of the forests in the French zone of Morocco are in charge of a special governmental department, which has given particular attention during recent years to the working of the cork forests of Mamora These cover more than 500 square miles between Rabat and Mequinez The bark is harvested by natives under the supervision of foresters brought out from France It is expected states the *Board of Trade Journal* that this forest alone will produce a revenue of some $800 000 within five or six years There are a number of other smaller cork oak areas in the region and in other districts there are valuable stands of thuya cedar oak, pine maple, juniper yew and argan Some of these are of great extent and contain magnificent trees, more especially cedars and oaks

Mexico: Its Political Situation, Its Resources, and Its Military Strength

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THE total area of the Republic of Mexico is only slightly less than that of our states east of the Mississippi, not including Florida. The terrain is varied. Both on the east and the west are great mountain chains paralleling the coast; these unite at the Isthmus of Tehuantepec and form a single ridge which continues on the western coast to Panama. From the Isthmus to an east and west line somewhat north of Mexico City there is what might be called a jumble of mountains with intervening valleys, most of which are highly fertile and well watered, a few being barren sand.

Between the two main mountain chains from the Rio Grande to the foothills north of the capital is a triangular shaped plain rising on a gradual slope to the southward. With the exception of an occasional river bed this plain is a desert.

The climate of Mexico is governed more by elevation than by latitude. On the coasts and over the entire Yucatan Peninsula it is that of the tropics. There are seasons of almost continual rain, the occasional bursts of sunlight causing the entire country to steam. During the winter months the climate of the coast states is exceedingly pleasant.

Over the great central plain the climate is that of southern New Mexico and Arizona. The lower latitude makes the heat of the sunlit hours more intense, the greater altitude results in generally colder nights. Farther south in the densely populated Federal District and its surrounding states the elevation, combined with the latitude, result in a climate unsurpassed by that of any district in the world.

Of the people of Mexico at the last census something over fifteen millions it was estimated that 20 per cent were of pure Caucasian blood. The remaining 80 per cent was about equally divided between Indians and mixed bloods. It is probable that the disturbances of the last four years have materially lessened the percentage of pure whites. About 50 per cent of the people are illiterate.

Excepting in the sections where foreign capital has intervened, in the cities and on the great estates of the hacienderos, the methods of life are most primitive. The country as a whole may be said to be practically undeveloped. In some sections there are tribes of Indians who have never been reduced to subjection, though during the last of the administration of Diaz they were nearly so. Such progress as has been made has been due almost entirely to the encouragement given by Diaz to foreigners to open the country and to the peonage system of compulsory labor. This last however was largely responsible for Diaz's enforced retirement.

Compared to the United States there are very few railroads and most of these are government owned, their revenues however being heavily pledged. Four lines leave the border, the most easterly ending at Tampico, the most westerly at Guaymas, and the two central running to Mexico City and thence to Vera Cruz and the Isthmus of Tehuantepec. There are several branch lines tapping the rich and thickly populated states in the vicinity of the capital, and a single line crosses the Isthmus of Tehuantepec and continues south to the Guatamalan border.

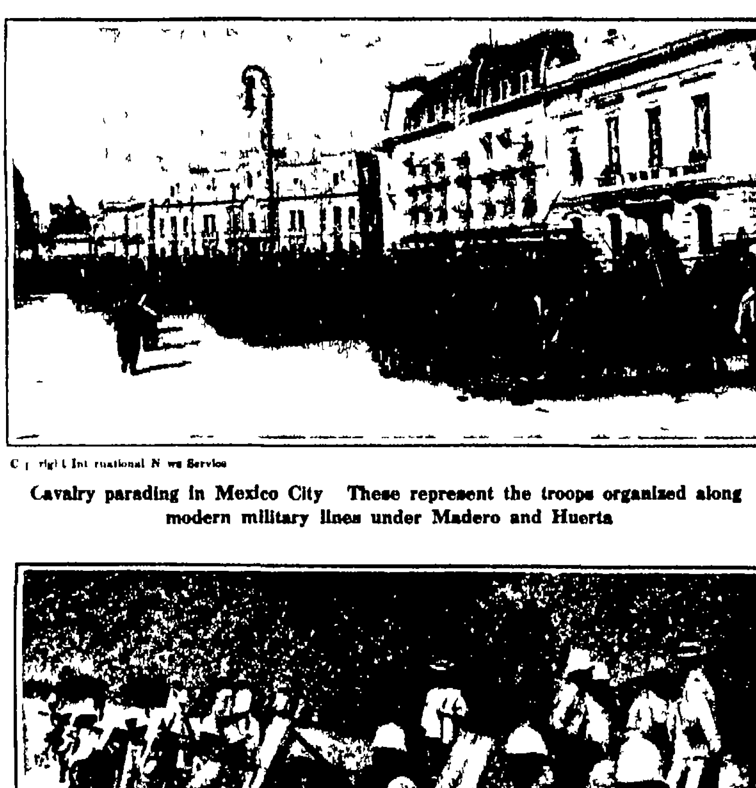
Good wagon roads are almost unknown except in central Mexico. Prior to the railroads the old "camino real" from Mexico to Vera Cruz was well maintained, but when the railroad relieved them from the necessity the Mexicans permitted it to fall into disrepair and now many sections are passable only for pack animals.

THIS article, a plea for better understanding, has been prepared by one who served in the Army during the Spanish and Filipino Campaigns, and who was later connected for years with the Civil Government of those islands. He has lived also among the Mexican people and has made a deep study of that country's condition as a parallel to that existing during the first six years of our oriental colonial experiment in the Philippines. EDITOR.

From the foregoing it will be plain to the military reader that the control of Mexico presents to-day the same problem, substantially, that it presented a century ago. It calls merely for the occupation of the coast cities having railroad termini and of the main routes of travel. This places in the hands of the forces occupying these points and routes all the commerce and practically all the resources of the country. Nor does the occupation need to be so extended. If the shaded sections of the map were securely held, the absence of roads of any kind would permit little communication and no effective coöperation between the sections of the country separated, which could then be taken, one by one, and reduced in detail if necessary or desirable.

Each subdivision would be entirely dependent upon its own resources, not only for the daily necessaries of life for its inhabitants, but for the munitions to continue a campaign of resistance. Nothing could enter the country from abroad, especially if a reasonably effective naval blockade were established. The occupation of the Isthmus of Tehuantepec would cut off any aid through Central America. Nothing would remain for the Mexicans except a guerilla warfare, more injurious, probably, to their own nationals, who would be exploited for the control of the several bands, than to the occupying army.

These facts illustrate the hopelessness of the present strife in that unhappy country. Lacking a cohesive people and a common objective, with transportation facilities unequal to the rapid mobilization and movement of an army of decisive size, it appears impossible for any one political party to subdue all its opponents unless the funds necessary for the equipment and support of a large army are made available, and the longer the struggle continues the less able are the people to stand taxation.



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Cavalry parading in Mexico City. These represent the troops organized along modern military lines under Madero and Huerta

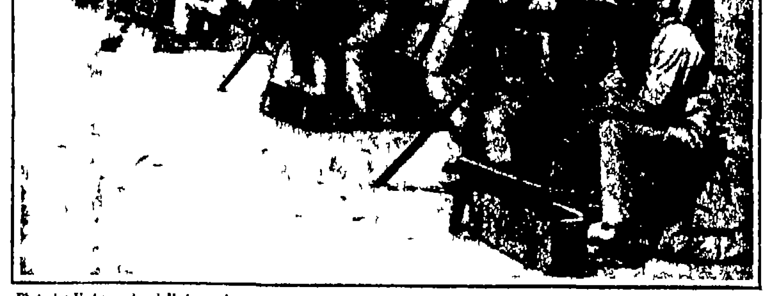

Photo by Underwood and Underwood

A rapid-fire squad of Constitutionalists

The Mexican Army under Diaz was fairly efficient. He established military zones under control of divisional troops, and raised a force of rurales which gave valuable assistance in obtaining information and in acting as guides for the regular troops. He established military schools in which the officers were well prepared for their duties. His army was comparatively well equipped and was thoroughly disciplined. All branches, infantry, cavalry, field artillery and engineers were represented, though not in the proportions best adapted for combined service. In all, he had about fifty thousand effectives.

The reorganization started under Madero and completed by Huerta was along modern lines. The military zones were discontinued and the army organized by tactical divisions. On paper it amounted to over one hundred thousand men, actually it never reached a number greater than sixty thousand, and these were inferior to Diaz's troops in every respect, the greater part of the soldiers being forced into the ranks, and a large percentage being of the criminal element. Doubtless, however, Huerta would have held his own in central Mexico had he been able to obtain the necessary arms and ammunition for his men.

The Carranza-Villa forces which overthrew Huerta were hard riders from the northern plains. The major portion of their troops were mounted infantry. They had a limited amount of artillery, but reports do not indicate that either the Federals or the Constitutionalists could use this arm effectively. And there was no strategy in their conduct of operations. These partook of the character of minor tactics, the operations of the next day being based upon the success or failure of the present day's action. Zapata, the independent bandit ruler of Morelos, also was a thorn in Huerta's side.

With the departure of Huerta and the following rupture between Carranza and Villa, there was again a dissolution of the armed forces. The major portion of their joint army remained loyal to Villa, who was the idol of the rough and ready adventurers, while the remnants of the old Diaz army and Huerta's federals stood by Carranza, at least half heartedly. But the fortunes of the First Chief were at a low ebb, and had Villa possessed the same genius for organization that he had displayed as a leader of irregular troops, he might have

Photo by Underwood and Underwood

A twelve-year-old Mexican soldier

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Mexican field artillery being moved into position

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Stopping for a bite to eat

eliminated his former associate.

Fortunately for Carranza he had the wit to appreciate the ability of the only true military genius that the four years of strife had developed among the Mexicans, General Obregon, young, energetic, fearless and, in spite of many temptations loyal, has succeeded in uniting the scattered fragments of the armies of the several different governments into what appears, at least, to be an effective whole. In spite of initial defeats he forced the opposing faction to withdraw from the Federal District and then in two pitched battles routed the Villa forces and destroyed the bandit chief's reputation for invincibility. And he has consolidated his advantages in the sections his forces have occupied. It is his army, estimated at about forty thousand men all accustomed to campaign that forms the military strength of Mexico to-day. It is a very small force for the territory to be policed, its organization would cause a military man of Europe to smile. The equipment is what they can get. There are field guns from France and Germany, rifles from Germany, from Spain, and from different factories in the United States, machine guns of equally varied models, while the commissariat is what the women camp followers can buy or forage from the country and cook for the men after the day's march. That Obregon has been able to accomplish the results he has is remarkable.

It has been said, and with truth, that every adult male Mexican is a bearer of arms. The country has been likened to an armed camp. But only uniformity of equipment can make a dependable army. The day of the hastily gathered volunteers, each bringing his own weapon, passed a hundred years ago. The country is not self-supporting when it comes to munitions. There are four factories in the neighborhood of Mexico City, two for small arms ammunition (and these for the Mauser rifles with which the army was formerly equipped and most of which must be worn out) one for field artillery ammunition, and the fourth practically a repair shop. All are of limited capacity and dependent upon machines and materials largely imported.

Should Mexico become involved in a war to-day, a war which would cause the cessation of shipment of arms and ammunition from the United States the inevitable end could be easily anticipated. It is certain that during the past two years she has received nothing from Europe which has needed its entire output and it is equally certain that the supplies she has received from this country have been insufficient to make up for the wastage of even such sporadic campaigning as the contending forces have undertaken. Small arms deteriorate rapidly in war. The Mexican soldier is prone to shoot away ammunition freely and this especially when the rifle is not cleaned intelligently and immediately results in rapid erosion of the bore and increasing inaccuracy. The small number of casualties in their various battles may be due as much to inaccurate weapons as to poor marksmanship and discipline. After a few reverses in which the arms of the dead, the wounded and the panic stricken were abandoned on the field it is doubtful if the Mexicans could put in service all forces combined a properly equipped army of the size now serving under Obregon.

The country is highly favorable to the defenders but only for a delaying action. The occupation of the coast cities is as shown by our own Vera Cruz experience a simple matter. They have no harbor defenses worthy of the name and no navy. The seizing of the Isthmus of Tehuantepec is little more of a problem if undertaken simultaneously from each coast. To penetrate from Vera Cruz to

(Concluded on page 456)

Map of Mexico showing shaded, the areas which possess any military importance

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Mexican Federal Cavalry on the march near New Laredo

Photo by Underwood and Underwood

A Mexican battery of light field guns

The Heavens in May, 1916

The Great Globular Cluster of Stars in Hercules

By Prof Henry Norris Russell, Ph D.

FOR two or three months past we have devoted our attention in these columns largely to the planets It is high time now to turn to the stars and consider some recent work that has been done upon objects incomparably more remote than any of our planetary neighbors

In the constellation Hercules on the line joining the bright stars Eta (η) and Zeta (ζ) (which may be found upon our map) and about one third of the way from the former toward the latter may be seen a little hazy speck of light The unaided eye on a dark night can just detect its existence With a field glass one can see two small stars, and near them a diffused luminous mass, looking somewhat as the Praesepe cluster does to the naked eye but much smaller

With a fair sized telescope—say of from 6 to 10 inches in aperture—this mass is "resolved" into a great globular cluster of stars—very faint individually, but so exceedingly numerous as to present a magnificent spectacle With the greatest telescopes the cluster is a most impressive object—the whole field of view being strewn thickly with countless points of light Photographs of long exposure such as have been obtained with some of the larger reflectors, show even more and reveal a globular aggregation densest at the center and fully 15 minutes of arc in diameter, containing about 50 000 stars brighter than the 21st magnitude (that is than the faintest stars which can be photographed with the great Mount Wilson reflector in six or eight hours exposure), and probably many more still fainter stars

It is therefore clear that we are dealing with a most remarkable object and many questions present themselves to be answered—if we can

Are these luminous points so closely crowded into one little area of the sky, really stars like those which are more sparsely sown in space near us? Is each individual one among them a *sun?* And if so, are they as big and bright as our own sun? How far apart are they from one another? And at what distance from us?

Answers, in part at least to these inquiries are now possible though even two or three years ago they would have seemed quite out of reach

The first contribution was made by Fath, who photographed the spectrum of the light of the cluster and found that it was of the ordinary sort crossed by dark lines showing that the source of the light was really in star like bodies of constellations essentially similar to the sun's.

Later spectrograms made at Mount Wilson, showed the spectra of a number of the individual stars which were found to be of various types—ranging from that of Sirius to that of the sun—but all quite similar to those which are found among other stars

Like the nearer stars, the members of the cluster differ also in color—as was first shown by Barnard by comparing photographs taken on ordinary and isochromatic plates This matter has very recently been made the object of an extensive study by Shapley at Mount Wilson, with important results He finds that the range in color among the cluster stars is extensive as great as is found among the stars visible to the naked eye Some of the members of the cluster are as blue as the stars in Orion, while others are as red as Aldebaran or even Antares, and all intermediate colors are represented From this fact alone conclusions of much interest may be drawn It has been supposed by several investigators that there exists a minute absorption of light in space of such a nature that the blue light is weakened more than the red. If this is so the remoter stars should appear redder the farther off they are and in this cluster which is undoubtedly very remote those stars which, if nearer us would be bluish white should look yellow those which would otherwise be yellow would seem red and those naturally red would have their redness greatly exaggerated. That is while the stars would still appear to differ from one another in color the range of color, instead of being from bluish white to red would be from yellow to excessively red

Nothing of this kind is found by observation, and it is therefore rendered very probable that in the direction of the cluster at least there is nothing in space to absorb one kind of light more than another

Another deduction is of still greater interest to the general reader It is found that the brightest stars are all red or orange On passing to those a little fainter many white stars are found, and among those fainter yet of the 15th and 16th magnitudes, all the stars are white or at most yellowish, in color

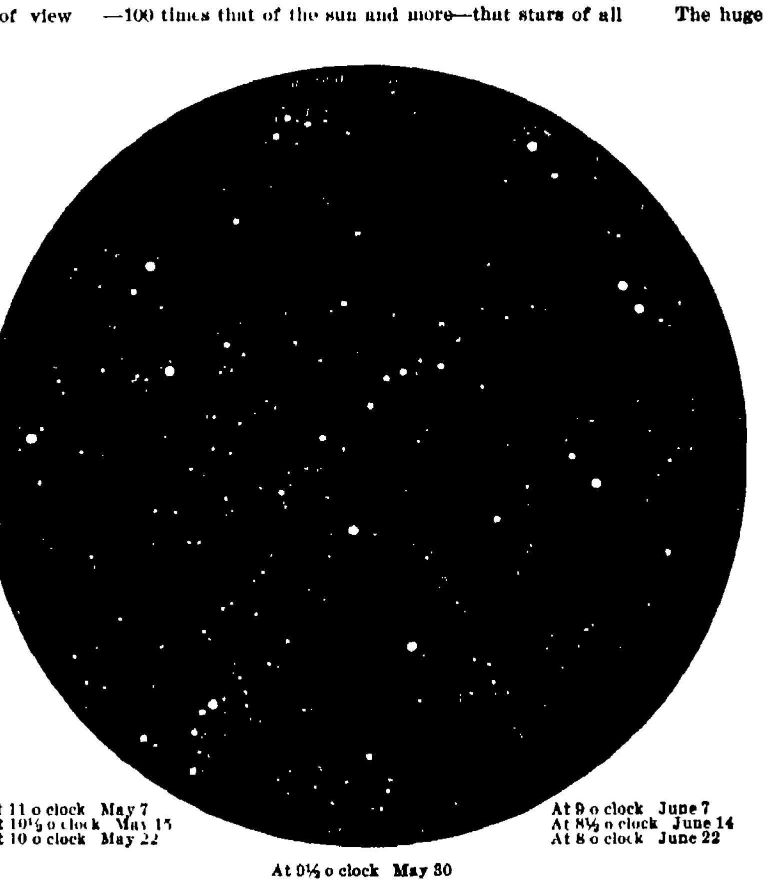
Now among the stars whose distances we can measure and whose real brightness we can calculate, it is found that some of the very brightest are red—for example, Antares which is in reality about 3 000 times as bright as the sun Among the stars of brightness 20 to 100 times that of the sun, however the great majority are white Stars ten times as bright as the sun are likely to be yellowish, and those of the sun's brightness like the sun itself, are yellow, while the still fainter ones are orange and red

It is only among the stars of greatest real luminosity —100 times that of the sun and more—that stars of all colors and of the same brightness may be found This makes it very probable that the brighter stars in the Hercules cluster which show a similar wide range in color are also objects of great real brightness, and that those somewhat fainter stars which are almost all white are comparable to Sirius and Vega

If this is true, the distance of the cluster must indeed be enormous to reduce such brilliant stars to their apparent inconspicuousness Data are not yet available for a precise estimate, but it appears that the distance must be of the order of magnitude of fifty thousand light years, or 3,000 million times the distance of the sun

This makes the cluster a really stupendous affair—fifty thousand stars, all brighter than the sun, and the brightest ones exceeding it more than a thousand fold scattered through a region some 200 light years in diameter

Within a similar distance from the sun there are probably much less than one tenth as many stars of equal brightness so that the stars must be much nearer one another in the cluster, especially in its denser central portions than in the region of space in which our system lies Even so they would not be embarrassingly close neighbors, being separated by tens of thousands of times the distance which divides us from the sun. In all probability the individual stars are moving, each in its own orbit around the center of the swarm as a whole A simple calculation shows that if this is so a single circuit would take more than a million years—so that it is not surprising that no relative motion has been detected among the stars of the cluster in the decade or two since the first accurate photographs were obtained.



At 11 o clock May 7
At 10½ o clock May 15
At 10 o clock May 22

At 9½ o clock May 30

At 9 o clock June 7
At 8½ o clock June 14
At 8 o clock June 22

NIGHT SKY MAY AND JUNE

The Heavens

The region of the sky about which we have been speaking may be found on our map east of the zenith and one third of the way from the bright star Vega—the brightest object in the northeastern sky—towards Arcturus, which is high in the south. Below Vega is the cross of Cygnus—now lying on its side—and due east is Altair In the southeast are Ophiuchus and Serpens, and farther to the right is Scorpio—its head well up, though the tail is barely rising Above and to the right is Virgo, and lower down, close to the southern horizon, is part of Centaurus.

Observers in southern Florida and at points farther south may at this season see the Southern Cross, still farther south and a little west of the meridian, and the bright stars Alpha and Beta Centauri, farther to the east

The huge sea serpent, Hydra, stretches from west to south, low down in the sky, with the Raven perched on his back Leo and Ursa Major are high in the west and northwest. Gemini and Auriga are setting below them Cassiopeia is low in the north, while Ursa Minor and Draco are high above the Pole

The Planets

Mercury is an evening star all through May and is conspicuous in the middle of the month, setting at about 9 05 P M He is then in Taurus about 21° from the sun, and looks a little brighter than Aldebaran He remains easily visible till the last week of the month, when he begins to draw in toward the sun appreciably

Venus is likewise an evening star, and is at her very brightest—more than ten times as bright as Sirius—and at the same time very far north—27° from the equator—so that she is as conspicuous as it is possible for her to become

She has not been as prominent for eight years past, nor will she be so again until 1924. At eight year intervals, however, the earth and Venus return to nearly the same relative positions, and the phenomena approximately repeat themselves

The planet is high in the northwest after dark, and remains in sight until 10 50 P.M. She is very easily visible in the daytime if one knows where to look for her Telescopically, she appears as a rather wide crescent, 20" across from horn to horn at the beginning of the month and 41" at its close. At the latter date the crescent shape can be easily seen with a powerful field glass

Mars is in quadrature with the sun on the 14th and crosses the meridian at 6 P M He is moving eastward in the sky from Cancer to Leo, and growing fainter, but is still brighter than Regulus

Jupiter is a morning star in Pisces, rising about 3 30 A M in the middle of the month Saturn is an evening star in Gemini, setting at 11 30 on the 1st and 9 30 on the 31st. On the 24th he is in conjunction with Venus, the planets being about 3½° apart.

Uranus is in Capricornus, visible before sunrise, and Neptune is in Cancer, observable in the early evening.

The moon is new at midnight on the 1st, in her first quarter at 4 A M on the 10th, full at 9 A M on the 17th, in her last quarter at midnight on the 23d, and new again at 3 P.M on the 31st. She is nearest us on the 19th and farthest away on the 7th During the month she passes near Mercury on the 3d, Venus on the 6th, Saturn on the 7th, Neptune on the 8th, Mars on the 10th, Uranus on the 23d, and Jupiter on the 28th.

PRINCETON UNIVERSITY OBSERVATORY
April 18th, 1916.

Manufacture of Needles in England

IT is reported that at least eight concerns began to manufacture needles in England during 1915, and that the total production of needles in that country at present amounts to about 250,000 per week. To the lay mind it would seem that the output is out of all proportion to the possible demand, yet it is learned that the demand totals about 500,000 needles per week, hence the output is inadequate.

War Game—VII

The Decisive Attack, Enveloping Both Flanks of the Enemy

By Guido von Horvath

WITH the development of the combat, and the information constantly gained from small reconnoitering detachments, patrols in the service of information the commander must make his decision on two important questions *when* and *where* to deliver the decisive attack

From the previous War Games it will be evident that in answering these two questions the time element is most vital The deployment of a company can be made very easily and very quickly It can be placed in position for fire action in an amazingly short space of time When, however it comes to larger bodies to fronts extended wider than a mile, the maneuver for position for a decisive action may take several hours

Therefore, in the present War Game, where the Blue detachment, commanded by Colonel K, is facing three battalions of Red infantry and one regiment of Red cavalry on a front of over a mile and a half some hours will naturally be required to bring about the necessary shifting of the troops of the First Infantry Brigade commanded by Brigadier General G

The forces of the First Brigade gain the decision as far as the battle on Lookout Hill is concerned But to bring about this result the brigade commander must make his decision far ahead, even before his own brigade is in actual touch with the enemy He must direct his forces by every means at his disposal in such a way that the shifting of the troops should aid the teamwork of the other troops on the field of battle He must time every movement to a nicety and must be able at any time to know where every fraction of his command is located

Above all, he must know when the decisive thrust must be delivered

Therefore the various columns composing the forces in hand must be directed, while still in their march formations towards the positions in which they will have to act. Roads, railroads, boats and all other means of transportation must be utilized and every effort made to bring about these maneuvers with as much rapidity as possible

The march of infantry is a slow procedure In addition marching saps the strength, and after a certain time diminishes the fighting capacity of the troops In modern tactics the transportation of infantry by rail, boat automobiles, or by any other means available, is a great factor It offers rapid action and supplies fresh dashing troops and besides gives a chance to surprise the enemy

In the problems offered in the present War Game we must consider the question of leadership Up to the time when the First Brigade made its appearance Colonel K was in command of the Blue troops The order dated "Norrisville, 7 June, 19—, 5 00 P M signed Brigadier General G, changed the situation in as far as the general developments are concerned Until the receipt of this order Colonel K was free in taking steps to accomplish the mission assigned to him to make a move according to his own plans From this time he must shape his plans to fit the orders of the brigade commander, who automatically takes command of the entire force

The General's orders are that Colonel K shall hold his position. The arrival of the brigade will force a favorable decision Colonel K's actions will be such as will assist the brigade in the accomplishment of its mission. With this goes the duty of informing the brigade commander of every matter which is deemed of value in promoting his plans.

For these reasons, at the first opportunity after the receipt of his orders, Colonel K should make an attempt to put himself in communication with his commander Telegraph wireless telephone, signal or messenger service may be used

We assume at 9 30 P M June 7th, Colonel K is in communication with Brigadier General G and sends the following report

Blue Detachment, Lookout Hill
Southeast of Argus Farm
7 June, 19—, 9 30 P M

To General G

The enemy, with one regiment of cavalry three battalions of infantry and a battery has a line extending west southwest from Timcum Creek and is in close touch with our defensive position Enemy battery has been moved to right flank behind wooded hilltop

Layout of Timcum Creek and Green Lake region offers opportunity to cut enemy line of communication with their main forces and to completely crush him

To afford quick transportation for two battalions of infantry I have secured two river steamers and hold them at Railway Bridge southwest of Potts town

Platoon of Engineers is at northern edge of Pine Forest in readiness, with small boats to prepare landing further upstream.

I shall hold my present position on Lookout Hill

K
Colonel

At this time the situation is as follows

The advance troops of the Blues Colonel K's detachment did not succeed in defeating the Red advance troops but on account of the distance between them and the Red main troops the Blues have accomplished their mission of holding the Pottstown bridges

A study of the terrain will give some interesting information Since the advance of the Reds across the creek did not proceed swiftly enough to throw the Blues back and force them across the Schaming River the left wing of the Reds composed of the infantry battalions is in a precarious situation, in view of the flanking attack of the Blue infantry brigade The creek and the lake are at the back of the Reds. The only line of retreat for these forces in case of an overwhelming attack from the southwest would be across that single bridge In case of such an attack it is very clear that a retreat would mean a disaster

Had the battery retained its original position behind the Bixler buildings it could have assisted the infantry in reaching the defensive line behind Timcum Creek and eventually would have covered the bridge so as to enable these troops to retreat still farther to the edge of the Lebanon Forest As it is, the Red commander must have plans of a different nature. These plans we shall see developed as soon as the action commences with the early morning light.

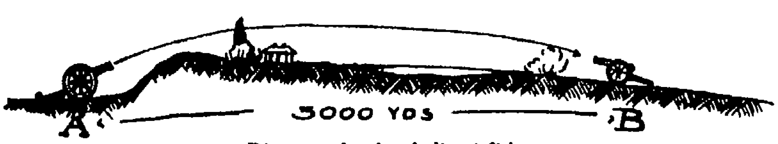
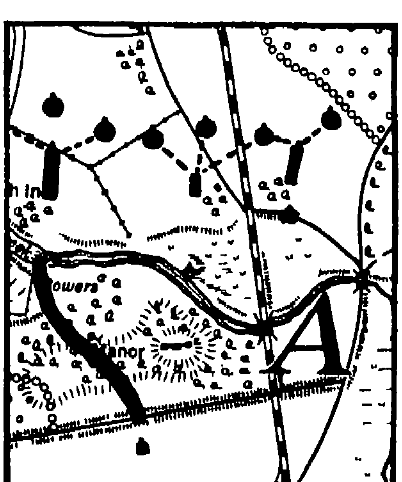
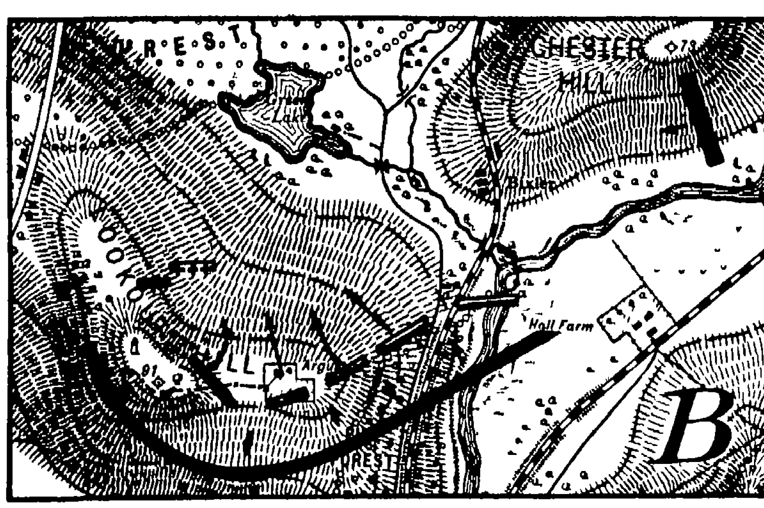


Diagram showing indirect firing

The gun at A can hit the gun at B by determining its distance and direction The direction is determined by reference to an agreed visible point Aiming Point instead of by reference to the points of the compass In the profile the Poplar Tree is the Aiming Point



Situation at 10 30 P M.



Situation at 5 40 A. M.

General Principles for a Decisive Attack

The first object of the commander and of the troops who seek to force a decision is to gain fire superiority over the enemy against whom they intend to deliver a decisive blow

In the engagements of the two previous War Games Colonel K has apparently held back strong reserves and has fought a delaying action Before the surprise appearance of the Red cavalry on his flank his intentions might have been set on seeking a decision but the developments of the combat changed his mind From now on however it will be his duty to act with his whole strength toward this end

The question of fire superiority where well trained troops are engaged on both sides, is a simple question of number of rifles and supply of ammunition Besides these two fire direction becomes important This latter is in great measure in the hands of the subordinate commanders who must select their section of the enemy front and their proper targets The commander's plan for the decisive attack will enlighten the subordinate commanders as to how and to what degree to apply the fire pressure on the enemy

The character of the opposing commander the enemy forces and their general fighting quality and the terrain all these must be weighed before the details of the action are communicated to the subordinate commanders

It is evident that as soon as the commander has used up his reserves he has lost his influence on the action This demands as a matter of course, that a certain reserve like a trump card should be held in hand until the time arrives for playing it Then however, the reserves should be thrown into the action with all their decisive force It is self evident that whatever maneuvers may be made, preparatory to the decisive attack, they should be made as secretly as possible and the cover offered by the terrain should be fully utilized Feints and misleading actions designed to deceive the enemy are useful elements in both tactics and strategy History records many brilliant exploits of this kind by great commanders

The judicious use of artillery will very often enable the infantry to close in on the enemy with insignificant losses Therefore the greater the difficulties the infantry may have in approaching the enemy the more fully developed should be the fire of the artillery

The climax of the combat is the assault by the infantry assisted to the very last moment by the artillery The assault of the major part of the force should be concentrated upon one vital point (See the explanation of the assault of a company of infantry in War Game III) Success at the well chosen point means ultimate success at all points

Application of Principles to the Present Game

The application of theoretical principles to the special case is always difficult Before entering upon the discussion of the present Game we shall consider certain distinctive phases with their bearing upon the present task

The present problem is to bring about a decision by means of the envelopment of both of the enemy flanks This involves the march of the Blue Brigade on the Greenville road to a point from which a deployment to envelop the enemy's right flank will be most promising This march is made at night Darkness affords protection but carries the danger of surprise

(Concluded on page 4 7)

The music practice building for the students of the School of Music, Northwestern University, which contains 28 sound-proof rooms

The new form of triangulation signal lamp operated by dry cells, which is to replace the present acetylene type

A Building With Sound-Proof Rooms for the Study of Music

THERE has been constructed at Evanston, Illinois, a suburb of Chicago, a building which is believed to be absolutely unique—the first in the world of its kind. It was preceded somewhat over a year ago by a cheap, wooden experimental building which served to demonstrate the practicability of the ideas involved. The present building, however, is a handsome two-story structure solely intended for the study of music.

Sound-proof floors, partitions and ceilings, forced warm air ventilation and hermetically sealed doors and windows are features of the unique music practice building for the students of the School of Music of the Northwestern University. The novel features of the building have been evolved by Irving Hamlin, Secretary of the School of Music. The structure houses 28 diminutive rooms, each measuring 6 by 9 feet, with ceilings 9 feet high. The rooms are eminently usable for music practice, their practicability, however, is only by reason of the peculiar construction of the doors—a patented invention—which prevents the transmission of sound from room to room, supplemented, of course, by sound-proof partition walls. In the existing music practice building of the school it had been found that a sufficient remoteness of one piano from another to furnish even a poor protection from the sound of a neighboring piano required rooms of at least 130 square feet of floor space. Comparing the latter figure with the 54 square feet of the rooms in the new building the saving in building costs is at once apparent, while the sound transmission is reduced to a minimum.

Four different methods of sound-proofing the partition walls have been adopted in different sections of the present music practice building in order to learn their respective worth for future use in a larger music building which it is hoped by the school authorities may be built in the future. No lath or plaster appears in the building except in that section of the structure where gypsum blocks have been used, in which case a thin coat of plaster was applied merely to give the blocks a smooth surface. Otherwise one-inch yellow pine sheathing has been used, covered with burlap; the latter in some instances is glued to the wall and in others merely hung taut in the manner of tapestried walls.

The windows of the building are double; the inside window is hermetically sealed, while the outside one is hinged outwardly for convenience in cleaning. At a distance of 25 feet from the building, it is said that the 28 pianos when in use can hardly be heard, thus amply protecting the neighboring property from sound intrusion.

Ventilation is effected by introducing air from out of doors at a point near the roof. It passes through a duct to the basement through heating coils, through a spray and thence by long individual pipes to the top of the wall in each room. A vent in the baseboard leads the air by an individual pipe to the attic where it escapes through a roof ventilator. The individual piping system prevents intercommunication of sounds between rooms. The entrance halls and corridors are heated directly by steam radiators, but the practice rooms receive all their heat, air and moisture through the ventilating system.

The music practice building is of mottled red brick, shingled roof, and is two stories in height, occupying a ground space of 28 by 59 feet. The interior woodwork is of birch in the natural color, the walls being covered with buff gray burlap. The doors simulate the so-called sanitary flush doors, two of that kind ⅞ inch thick being fastened together by means externally invisible with a ⅞ inch space between, the space in part occupied by sound-deadening quilt and in part by the hermetical sealing mechanism. The doors are so constructed that a downward push of the handle closes forcibly the crack between door and threshold, while the outer end of a finger, engaging with a cam, pushes the door unfailingly and forcibly against felt-mounted stop mouldings at the top and free edge of the door; in a word the door when closed practically makes the wall a continuous one. One fourth of the basement only is excavated for heating and ventilating machinery. The steam supply comes from the general heating plant of the University. The cost of the building was 19 cents per cubic foot.

Measuring Telephone Service With Meter Contained in Receiver

A TELEPHONE receiver has been invented by a resident of Webster City, Ia., which has as its main feature a special meter contained within the case and serving to register the actual time the instrument is in use. The receiver may be attached to any type of standard telephone equipment in a few moments' time.

The meter contained within the receiver case consists essentially of a size 16 seven-jeweled watch movement that counts minutes up to 9,999. When the receiver is placed to the ear nothing is heard until a button located on the side of the receiver case is depressed. This winds the watch movement, starts it and connects the instrument to the line; previously the meter has been set by means of a set screw for any length of time from three minutes up to five minutes, and at the expiration of the time limit the instrument is disconnected from the line. If it is then desired to converse for a longer period it is necessary to release the button and depress it again. The meter registers as low as one tenth of a minute and the person calling up pays only for the length of time he uses the service.

It is believed by the inventor that the new meter will have a marked effect on the telephone service and conditions of the present time, since it is claimed that the use of the device will eliminate about 75 per cent of the waste of time in telephone traffic. Each telephone subscriber will be as brief and as business-like in his conversation as possible. The batteries of the telephone systems will always be in good condition because they will be used and not abused. As a whole, the changes that are expected as a result of the employment of the meter will, it is expected, result in making telephone systems—the metropolitan systems which have already reached a high state of efficiency are naturally excepted—many times more effective than under present conditions.

The New Triangulation Signal Lamp of the U. S. Coast and Geodetic Survey

By E. G. Fischer

THE state, county and city surveyors must look to the national government for the exact geographical positions upon which to base their respective surveys. The duty to establish and furnish these positions devolves upon the United States Coast and Geodetic Survey.

The geodesist determines astronomically with the greatest possible exactness the longitude and latitude of selected principal points, suitably distributed over the whole country. The geographical positions of the many places between these principal points required are ascertained most accurately and economically by means of what is called triangulation. A rough, preliminary or reconnaissance survey reveals those points which are intervisible and most desirable as to distance and other characteristics, to form the corners of connected triangles. From the measured length of one side of a suitably selected one of these triangles and the angles of all the interconnected ones the exact latitude and longitude of each point is computed.

Though the general principle employed in the measurement of these angles is the same as that applied in the survey of a railroad, a farm, etc., the great distance between the points, varying between 10 and 100 miles and over, requires not only the use of specially large and refined instruments, but also a special means of making the point visible to the observer. This latter is now done in day time, by reflecting sun light to the observer from a mirror placed accurately over the point and at night by means of a specially constructed acetylene lamp.

It is apparent that distances of the magnitude mentioned can be penetrated by either means only under favorable weather conditions, and that many days during the season are lost even when the atmosphere is only slightly clouded by smoke, fog, etc. As the

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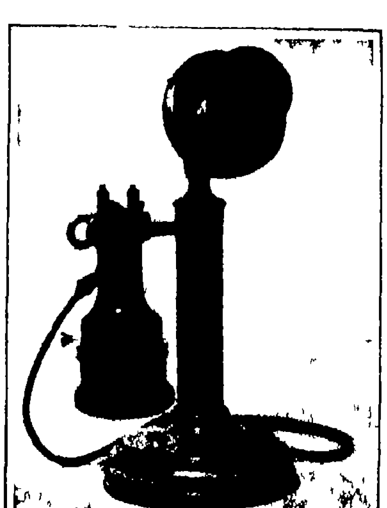
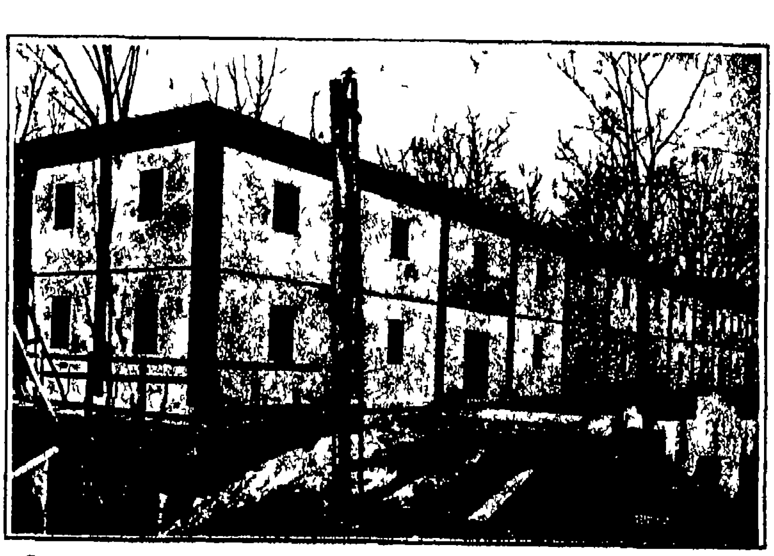
A House Built With Fifty-Six Varieties of Cement

THE Bureau of Standards is now conducting an interesting experiment in order to ascertain the wearing properties of various mixtures of cement. For this purpose there has been erected a long building, the sides of which are composed of 48 panels, each panel about 12 feet in height by 14 feet in length, while the ends have each four panels, thus the entire building represents a total of 56 panels made of as many different varieties of cement. In each instance the composition is plastered into place in the same manner as it would be in common practice, and

(Concluded on page 456)



Telephone instrument of the desk type fitted with meter



Cement-testing house erected by the Bureau of Standards. The walls comprise 56 panels, no two of which are of the same cement

How the War Put *One* American Engineer to the *Proof*

Twenty months ago, probably not one business man in this country realized that certain well established ideas would shortly be put to the hardest test in history.

In the light of this war, the world that prided itself so on being *practical* turned out to be *full of theories.*

Nowhere in business activity has theory shown itself so strongly intrenched as in motor truck engineering

Everybody had long foretold that the next war would be a *gasoline war.*

Everywhere in America it was assumed that in event of war an army could simply take over the output of *commercial truck builders*

In the unsparing test of war service, this theory falls to the ground.

Heavy weight, constant work, the *unexpected,* were always showing up the weak spots of a truck

But trucks like the Schnieder busses and delivery wagons of Paris, *built to meet war department specifications,* with a possible war in mind, are still running after nineteen months of war service

It is logical that the engineer who designed the Locomobile, the *first American-built car* to win the Vanderbilt Cup, should also be the man to build the *American business truck that takes rank in war service* with the European trucks built to war department specifications.

This engineer is A L. Riker, Vice-President and Chief Engineer of the Locomobile Company of America. Mr Riker was first president of the Society of Automobile Engineers, and was chosen by his fellow experts of the Society to represent them on the United States Naval Consulting Board, of which he is Chairman of the Committee on Internal Combustion Motors

A. L Riker is an engineer who has always refused to be limited to the conventions of his science, and has insisted on living in *close contact* with the *business world and its problems.*

He began his intimate study of motor truck transportation in the business world in the early days of the automobile

The trucks he designed and built fifteen years ago *are still running*

Mr. Riker's latest achievement is the new Riker Truck, a *war-tested truck,* a truck developed from the lessons of the war, designed by A L Riker and built by the Locomobile Company of America—unquestionably and incontestably *the best built truck in America*

For the first time in American industry, an engineer has provided for the business men of this country a motor truck designed to hold up in unsparing service and unexpected strains

A truck that is good for *war service* is ideally good for *business purposes*

The Riker Truck is the best built truck in America.

The Riker Truck has a frame of *chrome nickel steel,* as against the structural steel usual in truck practise.

Its engine bed is *government specification bronze,* instead of the aluminum ordinarily used This is the only bronze engine bed ever put into a truck.

Its springs are of *silico manganese steel*—no better truck springs are made either in America or abroad

Its transmission gears are of *chrome nickel steel,* its propeller shaft of *chrome nickel steel,* its driving axles of *chrome nickel steel*

There is *more high grade material* in the Riker Truck than in any other truck built in America

A Riker Truck *will go further, carry heavier loads, do its work* with *less tire cost, less upkeep and depreciation* than any other truck of the same rated capacity

The price is about the same

Engineers, Industrial Men, Superintendents of Delivery, Traffic Managers, Students of Technical Schools and Colleges, are invited to inspect the new Riker Truck, and see *Mr Riker's application of engineering principles to motor truck design in America.*

The Riker Truck is on display at all our Branch Houses, located in the leading industrial centers of the United States as follows·

New York City	Sixty-first Street, next to Broadway
Boston, Mass	700 Commonwealth Avenue
Chicago, Ill	2000 Michigan Avenue
San Francisco, Cal	230 Fulton Street
Philadelphia, Pa	Twenty-third and Market Streets
Los Angeles, Cal	Pico and Grand Avenue
Seattle, Wash	600 East Pike Street
Cincinnati, Ohio	911 Race Street
Oakland, Cal	Twelfth and Harrison Streets
Baltimore, Md	107 West Mt Royal Avenue
Washington, D C	1124 Connecticut Avenue
Pittsburgh, Pa	Euclid Avenue and Baum Street
Kansas City, Mo	1833 McGee Street
St Louis, Mo	3033 Locust Street
Minneapolis, Minn	1416 Harmon Place
Bridgeport, Conn	Seaside Park

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The New Triangulation Signal Lamp of the U S. Coast and Geodetic Survey

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expense to maintain the party, which amounts to from $50 to $60 per day, goes on whether observations are made or not It was thought that advances in illuminating devices made since the lamp now used was adopted might be utilized to increase considerably the intensity of the light directed to the observer, and thereby increase the number of observing nights

Experiments made with calcium light produced by the oxy acetylene flame showed this form of illumination to be impracticable by reason of the cost and bulkiness of the apparatus necessary

The storage cell was studied with the view of using electricity as a source of light Its cost and weight and the difficulties connected with its maintenance were found to be too great The electric generator with the necessary prime motor was carefully studied, tried experimentally and found to be too heavy for transporting to difficult stations and doubtful as to continued and unfailing service

The result of a series of tests of dry cells, which are readily divisible into loads suitable for climbing difficult ascents however warranted the design and construction of two new lamps the use of which undoubtedly will increase the present number of observing nights per month by at least 25 per cent

The main part an ordinary automobile headlight is suitably mounted for directing in the horizontal and vertical planes the lamp is provided with an ammeter a small rheostat, and a switch The whole packed in a strong case, weighs 23½ pounds

In order to obtain most nearly the maximum intensity of the light it was necessary that the lamp bulb be provided with a filament concentrated to a degree not found in those on the market One of the lamp manufacturers was induced to make the necessary designs and experimental tests, and submitted a number for trial

At the present time all the lights of the stations surrounding the observer's station are kept burning continuously from sunset to the closing of the observations for the night The use of the dry cell was found practicable and not too costly on the assumption that the proposed lamp was to be kept burning throughout the night The trial of the newly designed lamp by comparison with the present acetylene lamp, however, proved the former so much superior that it was decided to have the lights shown only on signal, flashed with one of the new lamps by the observer, for the few minutes each time it is observed upon. This reduces very materially the consumption of current and battery cost

The lamp after being provided with two additional bulbs, one for medium and one for short distances was tested by the Bureau of Standards, with the following results

Apparent candle power at a distance of 100 feet Lamp with specially concentrated filament, gas filled 6 volts 2 5 amperes	250 000
Automobile lamp, 6 volts 1 8 amperes	50 000
Flash light lamp 2 7 volts, ¾ ampere	6 000

The candle power of the acetylene lamp now used in the triangulation carried on by the Survey, measured under the same conditions, is 1 500

A House Built With Fifty-Six Varieties of Cement

(Concluded from page 454)

the object of the tests has been to determine what mixture "weathers" best, in other words which panel will stand the sun wind, rain and freezing temperatures of out-of-doors and remain in good condition

The principal hydraulic cements are termed natural cements, Portland cements and puzzolan cements. Natural cement is the product obtained by calcining an argillaceous limestone without pulverization or admixture of any other material, at a temperature above that used in burning lime, and by grinding the mass into a fine powder Most of the cement used abroad is of this variety. It sets more rapidly, but has less strength than the Portland cement

Portland cement was invented by an Englishman, Joseph Aspdin of Leeds, and was named for its resemblance to the limestone quarried on Portland Isle, Dorsetshire, England. It is a combination of silicates and aluminates of lime Puzzolan cement, on the other hand, is a mixture of siliceous and aluminous materials and is not burned in manufacturing It possesses the property of hardening in water

As cement of some kind is one of the most universally used materials in modern life the results of the experiment with the mixtures that go to make the walls of the Bureau of Standards' cement testing house will be awaited with interest by the building world

Mexico: Its Political Situation, Its Resources, and Its Military Strength

(Concluded from page 451)

Mexico City or from Monterey to Torreon would be an ugly if not a difficult problem

Two railroads lead from Vera Cruz to Mexico City Each is bordered by the remains of branches of the old royal road These railroads pass respectively north and south of Perote Mountain in the first half of their routing uniting at San Marcos One branch then goes south of the Tlaxcallan Mountains through Puebla the second city of the country, the other goes northwest through a fertile plain to Humantla They unite again at Apam and then run southwest to Mexico City, one on either side of Texcoco Lake.

This line offers some two hundred and twenty miles of as hard country for campaigning as can well be imagined, the distance is much greater by road or rail There are numberless places on each branch where both railroad and wagon road can be so damaged by demolitions that weeks of repair work would be necessary before trains or motor trucks could pass That the road has remained in operation practically through out the various revolutions is proof positive of the absolute dependence of all classes upon it Undoubtedly it would be destroyed before a foreign invader And there are many positions especially in the mountain passes where a small but determined force could check an army of any size until outflanked by movements over the most difficult country frequently impassable even for pack trains Unending opportunities are offered for dashing guerilla operations against the long line of communications.

But these are difficulties only A mountain country can delay an army, but only a position offering a broad field of fire and having its flanks resting on impassable obstacles, can resist indefinitely a superior force. And for such a defense an inexhaustible supply of ammunition is needed, as well as artillery equal in range to that possessed by the offensive These last have been conclusively demonstrated by the great European war Mexico possesses neither artillery nor reserves of ammunition, nor would she be able to obtain them Eventually Mexico City with the only source of supply, would fall Its occupation would take a short time or several months, according to whether the invader were willing to stand comparatively large losses in battle or was careful to conserve his forces by making no step without complete preparation Considering the sanitary conditions which prevail generally, it is probable that the former course would be the cheaper in expenditure of life.

The problem in the north is totally different. The country is open and generally given up to mesquite, a hardwood shrub—frequently forming almost impenetrable thickets. It would mean an invasion from Matamoras or Tampico, along the rivers or railroad for the necessary supply of water to the army There are on neither route the difficult positions such as exist between Vera Cruz and Mexico City, but a delaying action could be fought anywhere The defenders could use the railroad for supplies and reinforcements and destroy it as they retreated. It would be a tedious operation, and might be made costly by a well planned resistance. Mexico, however, has not the men nor the equipment to do more than delay a force approximating a division, especially if she were engaged elsewhere at the same time.

Fifty thousand well trained and well equipped men should be sufficient for the tasks described above To render absolutely safe the lines of communication, a force equal in size to the fighting force, and possibly a little larger, would be required, these line of communication troops, however, need be only infantry well supplied with machine guns

Such a campaign, as was intimated in the beginning of this article would destroy Mexico as a political entity Whether it would serve to restore order and bring unity to that unhappy country is a matter of doubt Probably an invader could obtain any demanded concession of territory and any promise of indemnity, but most likely he would have to fight to subdue the territory ceded and wait a long time for payment of the indemnity

For the restoration of peace in Mexico something more than violence is necessary In fact no violence not involving the killing of practically all the fighting men would accomplish this result The first revolution was due to the birth of a desire for freedom for a chance for the common people to be something more than peons The masses have had a taste of liberty if the word can be defamed by its use in connection with the license that has ruled At any rate, they have ceased to be slaves and will never go back to that status Those who say that Mexico needs a strong man—a second Diaz—blind their eyes to every lesson of history *Never yet have the masses definitely over thrown a government by class a government based on injustice, and then again become subservient to the same class That page in Mexico's history is closed*

What Mexico needs is a government that makes secure the home of the common people Given this and a voice in local affairs, and the appeal of the revolutionist would fall on deaf ears At present Mexico is filled with men whose wives are hungry, whose children are starving and with others whose families have died of disease or want, or both The former, prevented from earning a living by the disorganization of all industries, hopeless of obtaining employment of a peaceful nature which will supply the needs of those dependent upon them, turn to a life of violence which alone promises even temporary relief! the latter having lost everything held dear, and actuated in many cases by a desire for vengeance upon the party they hold responsible for the disordered conditions, are careless of life, and will enlist in any cause opposed to that they hold blameworthy Hence endless disturbance and innumerable lawless bands preying on the helpless and adding new numbers to those who have lost hope

The condition is identical with the one we met and solved in the Philippine Islands After the dissolution of Aguinaldo's unstable and incomplete control of the islands, we had many local leaders to deal with. The first step was to break down the remnants of organized resistance, a simple task, for we had the organized military force to do it. Following this came serious complications. In many cases the officials, appointive and elective, who worked openly for the American government, worked at the same time sub-rosa for the secret government of our opponents, they collected taxes for us, and at the same time and by the same machinery for our enemies. And the friend of the day might be the enemy of the night. A section of the country strongly garrisoned would be peaceful, withdraw half the troops, and the arms and uniforms (carefully concealed while resistance was useless) would be brought out, and a new uprising would occur The return of the troops in force meant the disappearance at once of the enemy, and the reappearance of the white-clad, urbane, smiling *amigos* *

* Spanish-friends. The soldiers used it as a term for the treacherous natives who were openly loyal and secretly hostile.

We had to gain friends, and did it, by justice. Gradually, more and more, the people began to realize that we were to be trusted. The women discovered that their daughters were safe from violence that the sanitation we enforced meant that their babies could live, that their children—all of them—were to be taught to read and write. Young men and young women desiring to marry found that they could establish a home and would be protected therein. And all the people found that we would not only permit them to elect their own local officials and leave the details of local affairs to them, but that we honestly desired just that thing. In other words, we restored *hope* without which humanity becomes des perate.

Secret opposition ceased more collpera tion and honest coöperation was increas ingly evident Soon there remained only the bandits, and it is a fact that of these 90 per cent were captured through their own people. As a result, while we may not have the open gratitude of the Filipinos, we have their sincere regard, and among them is a degree of loyalty un suspected by Americans who have not gone among them freely and whose ob servations have been confined to political hotbeds such as Manila

It is this result in Mexico that our Army officers have in mind when they state that the solution of the Mexican problem will call for half a million of men over a period of five years There is, among some of our people, an idea that peace cannot come to Mexico unless we take that action It would be a gigantic task, a thankless task, and a very ex pensive undertaking

But such intervention will be entirely unnecessary if Mexico can throw aside her baseless suspicions of our motives and accept the aid we have so completely shown it is our desire to give If any leader of influence among them would call their attention to the hopelessness of their situation should the protecting mantle of the Monroe Doctrine be withdrawn would point out the long years of anarchy and wrong to all foreigners that we have suf fered rather than hurt their national pride, would frankly tell them that the United States has proved its friendship for Mexico and is the only friend she has powerful enough to protect her and anxious to help her—if such a leader would adopt and enforce a system of justice to all, high and low, in the section he controlled, he could easily obtain sub stantial aid and support from us, and those who opposed him would be cut off from supplies. It would require a man of large courage, for it is to be feared that baiting the "Gringo" in Mexico is to-day as popular politically as the word "independencia" was in the Philippines before the people began to understand.

The Mexican leaders must realize their utter helplessness for self-defense should any powerful nation care to intervene, they must realize that Mexico (for inter nationally she is responsible for any act committed within the bounds of the re public) has committed deeds during the past few years justifying the intervention of many different nations, they know that many of these acts have been against the bodies and property of citizens of the United States, they cannot fail to appre ciate in their secret hearts that, but for us, others would long since have exacted reparation, and of the educated class none can be so blind as to overlook the patent fact that our Government has withheld its own hand under the severest provoca tion. Our present expedition into Mexico is as strong a proof of our friendship as could be desired. We have sent our troops into what would probably be the very last section of the country selected by a mili tary strategist or by a statesman who had the injury of Mexico in mind.

Patriotism, common sense, nay, even the first law of nature, self-preservation, all demand that the Mexicans shall forget an ancient and wornout racial hostility and frankly accept the hand of friendship which has been extended to them for these weary months and years. Have they the leader wise enough to point the way? In spite of every discouragement, we must still hope so, for it is the con fidence and friendship of a united America we so earnestly desire, not the political control of our weaker brother American republics

War Game—VII

(*Concluded from page 453*)

in its wake

If you will recall the problem in the service of security, explained in War Game II you will know that it is certain that Red patrols are combing the terri tory For this reason the advance guard of the Blue Brigade will sooner or later encounter Red patrols More than likely the Red patrols will listen and hear the inevitable sound of tramping feet The patrols will evade an encounter in order to procure information as to the strength of the Blue forces The Reds have a comparatively large force of cavalry and such patrols can easily transmit their in formation to headquarters It must therefore be assumed that before the ad vance guard of the Blue Brigade could pass Oregon Farm the Red commander will be aware of the fact that strong enemy forces are threatening his right flank This information might lead to an early counter movement on his part

A glance at the edge of Lebanon Forest will show what a splendid defensive line is at the service of the Red commander if he wants to fight a long delaying ac tion to gain time for the arrival of his main forces from the north The strength of the position lies in the advantage of the covered defensive line offered by the forest, with a stretch made unapproach able by Green Lake Good communication with Greenville is afforded and a clear approach in front offering very little cover for the enemy Otter Creek, which divides the line is a great disadvantage, making it nearly impossible to shift re serves from one flank to the other All of these items are important, for they bring out clearly the possibilities of the coming engagement

Under any circumstances, the Red com mander would make his plans to resist an attack directed against his right flank. The Reds are the invading force. They are in territory hostile to them. Their cavalry regiment has six squadrons of 140 men each The infantry battalions num ber 700 men each The Red losses in dead and wounded are 70 men. This would put their fighting strength, with the bat tery, at slightly over 3,000 men

Against this force the Blues have over 6 000 men at their disposal The odds are rather over two to one This is un doubtedly an overwhelming strength Nevertheless, a defensive position could be successfully held by the Reds against these odds.

Aside from their numerical superiority the main advantage which the Blues have is their opportunity to strike a surprise blow This is the double envelopment of the Reds, chiefly made possible by the fact that Colonel K secured the two steamers for this very purpose.

Developments during the Night, and in the Morning

The infantry fire has practically ceased Occasionally it flickers up like a half burned log in the fireplace, only to die away again. At the least suspicion of a movement by the enemy a light rocket whizzes into the sky to give ghostly light to the battlefield The hours pass drag gingly Colonel K takes every opportu nity to get a bit of sleep, for he must be strong on the morrow His staff, how ever, is on the lookout.

At 11·00 P.M Colonel K is awakened by his adjutant and is advised that a sig nal message has been received from the brigade commander

Railroad Bridge,
Southwest of Pottstown,
7 June, 19—, 10 30 P M

Two battalions have embarked on river steamers and will leave here at 11·00 P.M. to land above Timcum Creek on right shore of Nehaminy

Your platoon of engineers will be at

the disposal of and receive orders from Major M commanding the detachment.

I will make a holding attack on the enemy at 4 00 A M to morrow, to give time for Major M s movement.

As soon as the enveloping forces of Major M attack the enemy s left flank you will advance in full force

I shall be on peak of Lookout Hill

G,
Brigadier General

Colonel K can now continue his interrupted sleep if he so desires The plans are well laid for success

With the first signs of dawn the field of action begins to waken The infantry fire which heretofore had pattered intermittently now becomes a continuous rattle With the first rays of the sun when the mists begin to lift the deep boom of the guns mingles in the concert Little white *puffs of smoke born of powder* fire, appear and vanish over the fighting lines, clouds of dust rise underneath the bursting shrapnel And in this apparent confusion the troops the commanders and every portion of the forces move think direct and carry out, each its own particular duty

At 4 30 A M the enemy artillery has been forced to retire to the forest edge and the dismounted cavalry follows gradually and in good order

At 5 00 A M the Red Infantry begins to retire They attempt a withdrawal across Tinicum Bridge, but the reserve battalion alone succeeds The other two battalions retire gradually with considerable loss toward Lebanon Forest The reserve battalion which recrossed Tinicum Creek is headed toward the forest edge, northeast of Green Lake

This movement continues until 5 40 A M at which time Colonel K advances his right One battalion of the brigade pushes forward to Hoard s Dairy The enemy has reached the edge of the forest and has developed a stronger firing line

At 6 15 A M from the east Major M attacks and surprises the enemy Having waited for this movement Colonel K orders a general advance of his detachment

Questions

Question 1 The situation of the Blue Brigade at 10 30 P M is shown on the map Using this as a basis mark the position of the same forces at 1 30 A M As we have stated before, infantry marches at the rate of three miles per hour Considering that this is a night march it will be advisable to figure that only 2½ miles per hour is covered

Question 2 The speed attained by the river steamers is 6 miles per hour Where will these transports be at 1 30 A M? Consider here also that the movement is made at night

Question 3 Suppose that Major M decides to land at a point slightly over 2 miles up-stream from the mouth of Tinicum Creek at what hour of the night will his force be in readiness on the shore? Provided, of course that the engineers have to make a pontoon landing with the aid of the small boats

Question 4 Compose an order for this landing Remember the enemy, our own forces a plan of action and the commander s intentions

Question 5 How will the force making the surprise attack move towards its destination? In march order, in line or in columns?

Question 6. The two battalions safely landed on wooded meadow are in readiness for the march Issue an order to be given by Major M to the patrols which he will send out

Question 7 The two battalions have reached Chester Hilltop at 4 30 A M and the firing of the holding attack begins What order will Major M give?

Answers to Questions in War Game VI

Question 1 This will involve the cutting out of small strips of cardboard to fit the troop signs. It is a good plan to make special signs for deployed companies, and where this is needed, to exchange the close formation signs with the deployed sign and vice versa

This simple, but tedious exercise will come in handy in the later War Games.

Question 2 Considering the advance in the beginning of the engagement, it is safe to suppose that the battle has exhausted all the company reserves. Now we know that two battalions have been engaged in the firing line, and that originally each of these battalions sent two companies on the firing line.

As soon as the company reserves are exhausted, the battalion commanders will send another company ahead to carry forward and strengthen the firing line This will, most likely put another platoon on the firing line and hold the remaining platoons for company reserves. Therefore the one must replace the other in due time In this present case, the long drawn-out combat will have exhausted the battalion reserves. But the detachment reserve, one battalion strong, should still be available

Question 3 The advantage of taking a position under cover is self-evident As we have before stated artillery can be used just as successfully when the gunners do not see the target, as when they are in full sight of the enemy This sort of firing is called *indirect fire* and is guided from an observation point. From the top of a tree or roof of a house, etc. It will offer better protection without diminishing the fire effect.

Question 4 The artillery in this case, is in a masked position and its fire is directed by reference to the so called *aiming point* The aiming point is in clear sight of the gunner laying the gun, and this point is selected in such a way that with the elevation given to the gun it will *direct the fire* upon the invisible target See diagram

Question 5 Full and complete answer will be found in War Game VII under chapter Considerations in regard to Present War Game

Question 6 Either he must decide to retreat to forest edge with all his forces or he might effect the partial withdrawal of his Infantry behind creek His order will simply point out new line of defense the *edge of* Lebanon Forest

* * * * * * *

The next War Game will deal with a piercing attack and will introduce entirely new formation and situations.

Recent Patent News from Washington

WE commented some time ago on a bill which had been presented to Congress the object of which was to prohibit members of Congress from lending their names for advertising purposes to persons, firms or corporations practicing before the Patent Office Serious abuse has arisen during the past few years in which patent attorneys have obtained letters of endorsement from members of Congress, which they have used to promote their private interests and to extend their business

In most cases it was evident from the tenor of those letters that the members of Congress who have thus been persuaded to lend their names have had no personal knowledge of the ability or business methods of those attorneys, and the use of this method of advertising has become such a scandal that it was deemed necessary to put a stop to such practice One of these firms even went so far as to publish in a pamphlet advertising its business the portrait of the Speaker of the House

That something should be done to put a stop to such practices has been recognized by Congress itself in the fact that it has passed the bill to correct such business methods

Owing to the unusual growth of the patent business of the country during the past few years, Commissioner of Patents Thomas Ewing, urges additional space for the Patent Office. In a letter to Secretary Lane, of the Interior Department, he asks for the second and third floors of the building, now occupied by the General Land Office, for the use of five divisions of his force—classifications, draftsman's, assignment, manuscript and photolithographs and publications. Commissioner Ewing says in his letter:

"It is only relieving this building of the five divisions of the Patent Office that we can make the proper disposition of the force which the demands of its work make necessary"

The need of 100 per cent expansion for the five divisions indicated is expressed in the letter

Commissioner Ewing urges the provision of additional stacking facilities for the copies of patents which are on sale to the public at the office. There are 1,400,000 patents, he states, and, working on the basis that it takes 1 foot of stacking space to take care of 16 patents, he figures that it will take 87,500 feet for the whole. The widening of the aisles between the stacks and the installation of steel shelving to minimize the constant danger of fire are advocated.

NEW BOOKS, ETC.

QUESTIONS AND SOLUTIONS IN TELEGRAPHY AND TELEPHONY Final Examinations Compiled by H P Few London S Rentell & Co, Ltd 12mo, 74 pp, illustrated Price, 1s 6d net.

This slim handbook is issued as a companion volume to the same author s 'Questions and Solutions in Telegraphy and Telephony Grade 1 Examinations It gives in full all the questions set by the City and Guilds of London Institute in both telegraphy and telephony, for the ten years, 1906 1915 and to the questions of 1915 are appended full solutions.

MISS AMERICAN DOLLARS. A Romance of Travel By Paul Myron Milwaukee, Wis. Mid Nation Publishers, 1916. 8vo, 301 pp, illustrated.

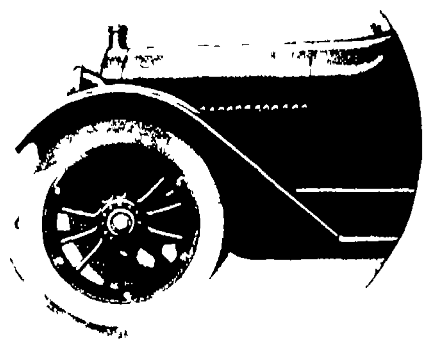
Although cast into fictional form, Judge Myron s story leads up to a consideration of the attitude of the United States toward the war and toward our own preparedness. Some very caustic criticism is placed in the mouth of an intelligent French woman, who is disgusted at our worship of mere size and quantity and although she later repudiates much of its exaggeration it is evident that the aim of the author is other than merely to entertain and that he seeks to awaken the country to the dangers of self sufficiency and carelessness. His intimate acquaintance with foreign lands gives us many authentic glimpses of Italy Greece, Turkey and Albania, with their tense political situations and interesting social conditions.

THE INTERNATIONAL MILITARY DIGEST ANNUAL. 1915 A Review of the Current Literature of Military Science New York Cumulative Digest Corporation, 1916. 8vo, 390 pp

It is no easy matter for our officers to keep thoroughly in touch with the military literature of the day Much important material appears only in foreign languages and even if they confine their reading to such articles as appear in the mother tongue, the volume of material is staggering The need of expert translation and selection is apparent, and this need, in spite of the difficulties attending new enterprises of this kind, is being capably met by The International Military Digest, a monthly publication, from which this annual is cumulated. The abstracts varying from one fifth to one twentieth the length of the original articles, carry citations referring the reader to the original source They are well chosen and in the highest degree informative The widest range of subjects is covered from aviation and ammunition to wounds and X ray technique, and the alphabetical arrangement, with its system of cross references, is an admirable aid to easy reference

THE "SHIPPING WORLD" YEAR BOOK A Desk Manual in Trade, Commerce and Navigation Edited by Evan Rowland Jones. London The "Shipping World" Offices 1916. 8vo, 2 010 pp, with new map of the world. Price, 11s.

The "Shipping World Year Book," a standard publication of British origin, long ago entered upon a wide sphere of usefulness among commercial and shipping interests. Recently many important alterations in port dues and charges have been made, and these are duly incorporated in the text during the past year the loading and discharging facilities and the cargo accommodation and equipment of many ports have been substantially increased; these particulars are of vital interest to the shipper The modifications and amplifications of existing tariffs—Australia, for example, has an entirely new tariff—have been numerous, entailing minute revision of this section of the Year Book. A new map, especially prepared by J C Bartholomew, plainly shows the world s steamship and railway routes, its ports, coaling stations, and coal fields, while among the many insets is one of the Panama Canal, tracing the waterway and its ports from Colon to the Pacific. The war has made necessary the retention of some old figures relating to subjects such as the tariffs of enemy countries; since, however, these countries are, for the most part, cut off from oversea trade, the omission of the latest statistics in no wise impairs the value of the Year Book as a work of reference.

Hup  mobile

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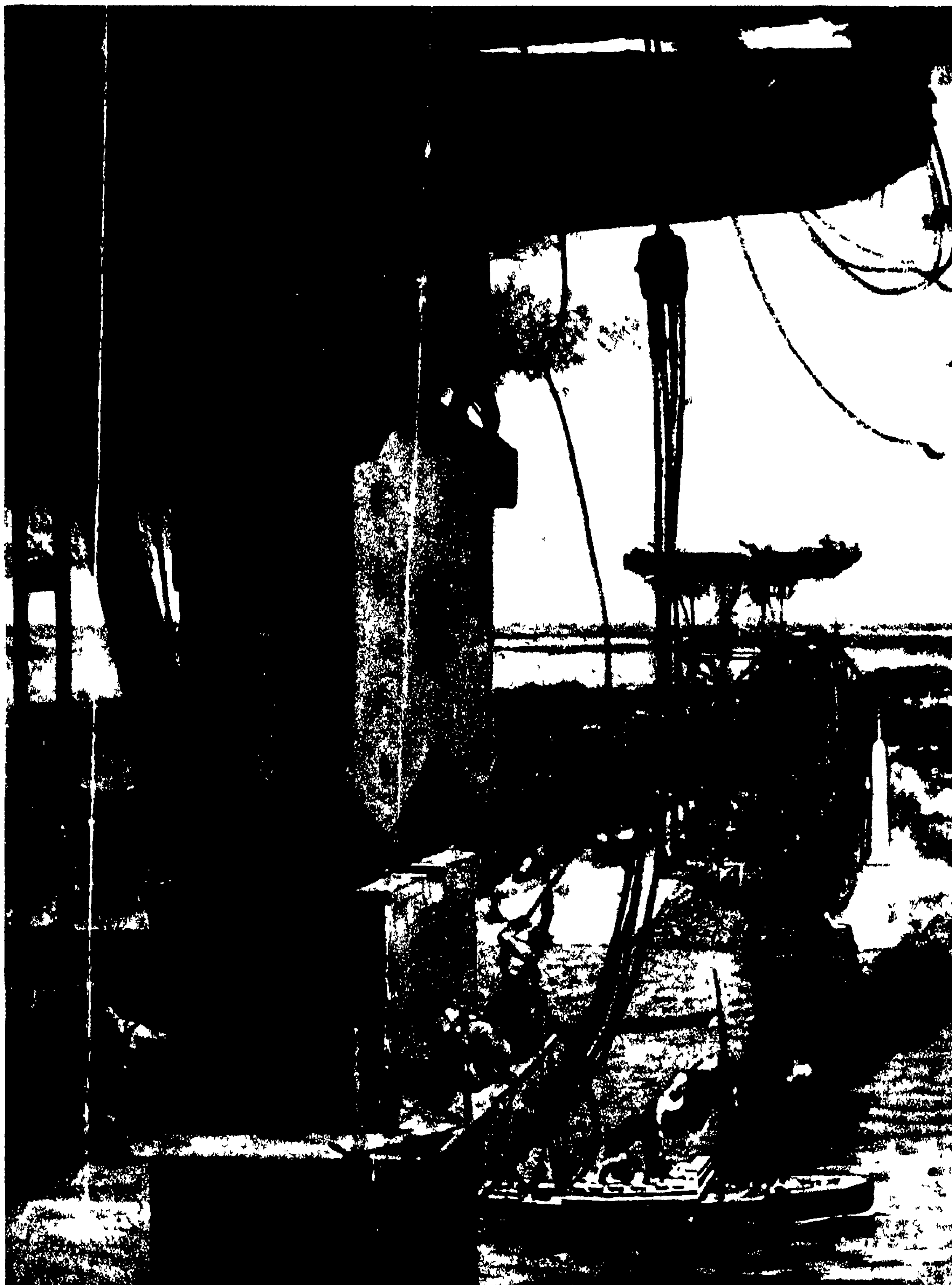

May 6, 1916

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New York, N. Y.

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SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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German aviator piloting his machine to a safe landing on an aviation field at night, guided by the newly-evolved beacons

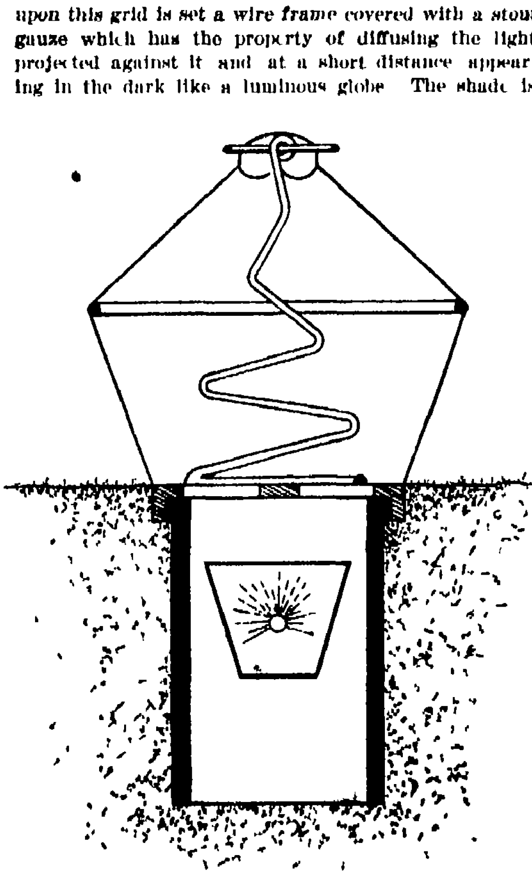
New Aviation Beacons That Make Safe the Landing of Aircraft at Night

By Robert G. Skerrett

THE Germans have lately evolved a type of lantern for aviation fields and other landing places which removes a number of the dangers to which the air pilot has heretofore been exposed in returning to earth at night. As may easily be appreciated, the proper lighting of aviation stations is confronted with a number of difficulties. Logically, it is undesirable to support the beacons on poles or towers, because the exact height of these can not be accurately judged after dark, and they are obstructions against which the airman may unwittingly strike. Further, the lights are proportionately blinding as their power of illumination is increased, and to the approaching pilot there is a zone of glare which screens the underlying ground, leaving him to hope that all is clear below.

In consequence, the aviator has had to use these navigational beacons with some reservations, and as a broad rule he has found it safest to steer wide of them in descending and really to make his landing somewhere in the neighboring darkened area. As a result, many accidents have occurred, and not a few of them, because of adventitious obstacles in the way of wagons, horses, and other bodies that have been left heedlessly or allowed to stray upon the grounds. The new beacon very effectually obviates the previous handicaps and is designed as a target, so to speak, at which the aviator can aim directly when making his landing and should be hit any exposed part of the apparatus no damage will be done either to the aircraft or to the lantern.

The light itself, backed by a suitable reflector casting the rays upward, is placed in a pit lined with firebrick. The latter is made in the form of an open-ended cylinder and is sunk with its upper end flush with the ground. Over this opening is placed a stout iron grating through which the light can pass skyward, and upon this grid is set a wire frame covered with a stout gauze which has the property of diffusing the light projected against it and at a short distance appearing in the dark like a luminous globe. The shade is held up by a spiral spring which collapses when a blow or weight is sustained by the screen. The character of the light is such that it produces an even glow and does not cast misleading shadows or occasion the equally deceptive reflections that are so common where a bare light is concerned. These lamps or beacons are placed upon the aviation field at regular intervals and spaced from 22 to 54 yards apart depending upon the area of the landing space and the nature of the illuminant. The lamps may be electric, oil or gas.



Cross-sectional view of one of the new German aviation beacons

The shades have a maximum diameter of something like 18 inches and a total height of about a foot so that they lie low and distribute the light very evenly upon the surrounding ground. More than this they can not be hit except by the landing wheels of the flying machine. They crush easily under such a blow and straighten up again immediately afterwards. The grating over the pit is strong enough to support the weight of a passing wheel and its load no matter how large the aircraft.

Steel Cars on Railway in India

THE Great Indian Peninsular Railway recently successfully experimented with one steel passenger coach and has now constructed an entire train of that material. This train runs as the Bombay Delhi Express carrying intermediate and third class passengers. Each carriage is 68 feet long and the body, including the roof is of steel plate riveted and welded to steel supporting members so that the whole of the body and the underframe on which the former is built as one piece are of steel. Inside the car proper the fittings and furniture in touch with the passengers are of wood as are the window frames venetians etc., while the actual lining is of asbestos heat resisting composition held up with wooden moldings secured to the steel members. An interesting point is that one carriage has all its internal woodwork made of Japanese ash as an experiment.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs

Fatuous Blindness of Germany

THE war has been a great revealer of national character, and the revelation has been full of the unexpected and surprising Those of us who appreciated the genius of the German people for organization and efficiency, and admired that strong logical bent which enabled them to move with such directness to their great industrial and commercial accomplishments, have been dumfounded by the total lack of moral and ethical qualities, as revealed in the gospel of might and frightfulness which the Germans have preached and practised throughout the war They alone, among the great nations of the world, seem either to have lost all regard for the approbation and opinion of mankind or to have become suddenly bereft, at least so far as morals and ethics are concerned, of the most elementary powers of reasoning

As evidence of this, consider the violent recrudescence of the murderous raids of the Zeppelins, whose victims are almost entirely unarmed combatants, at the very time when the German Government professes to be endeavoring to meet the humanitarian views of President Wilson on the subject of submarine warfare Everything that the President and the people of the United States have urged against the ruthlessness of the German commander of a submarine applies with equal emphasis (we are speaking now on the moral aspect of the question) to the slaying of non-combatants by the commander of a Zeppelin

That Germany should increase her activities in the one field at the very time when she is supposed to be looking for some reasonable basis on which to diminish her activities in the other field, is the latest of those many amazing contradictions that have made the civilized world ask over and over again, "What manner of people is this?"

One of two alternatives is certain Germany, in this wholesale running amuck among non-combatants not only of the belligerents but of the neutral powers, is doing so either with cold blooded but clear headed and deliberate intent, or she is proving on a most tragic scale, that brooding over fancied wrongs and too-long imagined plots and persecutions, may produce insanity in the nation even as in the individual

Submarine Nets for the Navy

A PROMINENT American business man who has recently returned from an extended business trip among the belligerent nations of Europe, tells us he was reliably informed that the Allies had "netted" a total of 130 submarines Not long before this our Navy Department learned through its own private sources of information that the total number of submarines captured or destroyed by this and other means was 127 The stout, steel chain net, suspended from buoys at the surface has been found to be a most effective means for keeping the submarine out of certain waters to be protected Moreover, long sections of netting towed between destroyers or, better, between trawlers, have proved most effective in intercepting and dragging into shoal water the submarine craft of the enemy

Many months ago Admiral Fletcher, recognizing the importance of this means of defense, asked the Department for netting of sufficient size and in sufficient quantity to enable the fleet to do some experimental work in this direction He secured some netting, which, on test, proved to be of too weak construction for the effective stopping and catching of submarines. Outside of this, the Navy is altogether without this most valuable element in the protection of our harbors and roadsteads, and of the fleet itself, against submarine attack.

Last year the SCIENTIFIC AMERICAN suggested that, in view of the enormous damage which could be done to our fleet, to our dockyards and to the merchant shipping in our various ports, by an unheralded submarine attack, it would be advisable to provide the Navy with several miles of specially constructed netting of the kind which has proved so successful in European waters. Just now, when the international crisis which we had in our mind when we wrote that article is upon us, and when, as our President recently stated in a public speech, we are in danger of being involved in the great European conflagration, common prudence suggests that we should at once manufacture a sufficiency of submarine netting to enable us, at short notice, to close our harbors, the approaches to our dock yards and any strategic waters which we might wish to protect.

Ordinary prudence, indeed, would lead us to go even further than that and, at once, throw netting across the approaches to our dockyards and around the waters which are used as anchorage ground during our fleet maneuvers For we should remember that the largest submarines employed in Europe to-day run from 800 to 1,500 tons in displacement Many of our naval officers, indeed, consider that it is quite possible Germany may have built one or more type ships of 2,000 tons, designed for special long-distance service. Undoubtedly there are submarines afloat which could make the transatlantic passage without convoy, fill up their oil bunkers in the West Indies, or at some point selected by the gentlemen whose activities in favor of one of the belligerents in this war have recently become so notorious, and then make an early morning surprise attack on our dockyards, in which, particularly at this outfitting season of the year, the finest of our dreadnought fleet might be sunk at its moorings

The Fate of the Shackleton Expedition

IN the autumn of 1914 Sir Ernest Shackleton and his party of explorers sailed away from civilization upon the bold emprise of crossing the Antarctic continent from side to side, an undertaking of both spectacular and scientific interest—"sporting feat, or whatever name it may go by," to quote the words of Shackleton himself When he departed he hoped to complete his journey in a few months, but foresaw the possibility of being delayed for a year in starting the transcontinental trip, and hence not returning home until the spring of 1916. The plan was, briefly, to disembark in the Weddell Sea region, then recently explored by a German expedition under Filchner, leaving a depot party on the coast, the leader and five companions were to travel overland 1 700 miles to Ross Sea, where they were to be met by a party sent out for that purpose in another ship The Weddell Sea party sailed in the "Endurance," the Ross Sea party in the "Aurora," and both were equipped with radio outfits

Subsequent events have been a series of disappointments to the explorers' friends and well wishers what ever they may have been to the expedition itself The departure was, in the first place, so much delayed that when, after a halt at South Georgia, the "Endurance" finally entered the ice, in January, 1915, it was already evident that the transcontinental journey could not be made that season. The "Aurora" left Australia in December, 1914, and, as is now known, made a landing in Ross Sea late in the following month Neither vessel returned, after landing parties according to schedule Moreover, the following (southern) winter went by, and nothing was heard from the expedition by wireless Then another season of navigation passed, and at the very end of it—late last March—the "Aurora" was reported by wireless to be limping homeward. In May, 1915, a blizzard drove her from her moorings, leaving a number of men on shore and unable to rejoin the ship. From that time until the middle of last March she had drifted in the pack ice.

The present situation is, therefore, that while a portion of the Ross Sea party is on land, and has probably been able to accomplish something in laying depots over the barrier ice in anticipation of the arrival of Shackleton and his companions, it is certain that such members of the expedition as are at Ross Sea must remain there for another year Meanwhile, nothing at all has been heard from the Weddell Sea party or its ship, the "Endurance," and their fate will remain unknown until next winter, unless they should succeed in establishing wireless communication with the outside world It is not even known whether Shackleton's party ever succeeded in setting foot at any point on the Antarctic shore

Lieut Filchner and his party, who entered Weddell Sea in December, 1911, were unable to effect a landing, but their ship was caught in the ice and drifted helplessly until the following November

If Shackleton is on land, and has not come to grief in an attempt to cross the continent, the unforeseen prolongation of his stay in the Antarctic will probably have no serious consequences, but will, on the other hand, afford the expedition an opportunity to carry out more extensive explorations than were originally planned.

Fortifications of the Future

ONE of the most startling surprises of the European War, not only to the laity, but to military men as well, was the comparative ease with which the big guns of the Germans battered down fortifications, such as those of Antwerp, which had been considered practically impregnable Under the iron hail from the "42-centimeters," massive masonry reinforced concrete crumbled like heaps of sand before a flood-tide. As a result, the entire scheme of defensive fortifications all over the world will undoubtedly undergo serious modification. Naturally enough, nowhere more than in France has the subject received grave and anxious consideration. Already a well known army man, Lieut.-Col. Boissonet has contributed an article upon the subject to the supplement of a leading French encyclopedia. His conclusions are based on a careful study of present conditions and will doubtless be of peculiar interest to all the advocates of "preparedness" in the United States. He declares that the number of fortresses will doubtless be greatly reduced, while those that remain will be entirely reconstructed at an enormous expense. He advocates the rasing of those not thus rebuilt according to modern ideas, on the ground that their conservation in their present condition would be more dangerous than useful Moreover, the sale of the sites of the latter would help to defray the cost of rebuilding the former

The main features of the newer style of defensive constructions are systems of connecting trenches and magazine batteries completely buried and masked, and protective networks of wire. He continues "The infantry works will be analogous in dimension and organisation to a German fortress (*feste*), in which there is neither a fort nor armored batteries, there will be a few batteries for the defense of the works and the concrete shelters, but these will be completely buried with no projection above ground. The shelters, of restricted dimensions, will so far as possible receive light and air from the side towards the interior of the fortress. The line of combat will be constituted by works of this type, mutually flanking each other as well as may be. The batteries meant to oppose the attacking batteries will, as a general rule, be placed behind the infantry works. They will be simple earthed batteries, completely hidden from view, but close by them will be magazines for munitions and shelters for the various troops.

These magazines and shelters will also be subterranean concreted, and so constructed as not to reveal their emplacements upon the surface. They will be of small size, but numerous, so that the destruction of one will not be of too serious consequence.

"All the infantry works, the batteries, the shelters, and the magazines, will be connected with each other by subterranean passages."

As regards the armament of such a fortification the author observes that it must consist of a large number of guns, which need not, however, be of large caliber since they will not be directed upon heavy masonry and concrete However, they must be well munitioned

He estimates the expense as exceedingly high, not so far as concerns the cost of the trenches and the wire, but first because of the great extent of territory covered, and second because of the indispensably large number of magazines, shelters, and communicating passages required.

"Each place must cover extensive territory for several reasons, the principal one being that usually each intrenchment will have a town or city in its interior It is not to protect such towns (with the exception of Paris), that these fortifications will be constructed, it is because the reasons that conduce to such fortification of any position—such as its being an important junction of roads, a convenient crossing point of a river, etc.—are the reasons which have naturally led previously to the foundation and growth of a city thereat"

In *outlining these requisites for the forts of the* future, Lieut. Col Boissonet has been guided by the reports of the commissions of Bourges and Châlons in 1886 and 1887, by the proposals of Gen. Langlois, by a study of the siege of Port Arthur, and by conditions actually obtaining in the present war. He concludes with the observation that when the contemplated reconstruction is undertaken after the close of the war, the first thing to be decided upon, independent of all strategic consideration, is the number of fortresses to be constructed, reminding his readers that since each will require a large and solid garrison it is advisable to have as few as are indispensable.

Electricity

Self-Regulated Electric Iron.—Equipped with a simple form of thermostat, there has been introduced an electric iron which automatically maintains its temperature at any desired point. Adjustments in temperature are effected by turning the knob, after which the thermostat member turns off the current when the heat exceeds the limit set and again closes the circuit when the temperature falls slightly below the lower limit.

Flashlamps and the War.—Attention has been called before in the columns of this journal to the wide employment of electric pocket lamps by the fighting men of Europe. According to a recent statement in the *Daily Mail*, it is learned that two London firms have produced between them no less than 2,000,000 batteries during the past year. Prior to the war only about 50,000 such batteries were made in the entire United Kingdom.

Specific Current Consumption of Gas-filled Tungsten Lamps.—In a recent issue of the *Electrical World* there appear the results of a series of experiments made by Ralph C. Robinson on gas-filled tungsten lamps. The experiments reveal that while the mean horizontal watts per candle-power are very different for different mountings of the filament, the watts per spherical candle-power are practically constant, about 0.8. The mean horizontal watts per candle-power were as follows for the different filament mountings: V shaped, 0.66; vertical, 0.595; horizontal, 0.082, and diagonal, 0.635.

Two New Patents on Lamp Filaments.—There has been granted to a Baltimore inventor a patent covering the use of satisfactory alloys of zirconium and iron in the making of tough, malleable and ductile lamp filaments. It is stated that these filaments also possess the property of selective radiation and have a high degree of luminosity at relatively low temperatures. A patent has also been granted to a Swiss inventor covering the preparation of tungsten for lamp filaments. By means of a resistance furnace the tungsten is fused to a perfectly liquid condition and then rapidly cooled by air blast. It is claimed that the process makes the tungsten exceedingly malleable and ductile.

The High-Rate Discharging of Storage Cells was the subject of a paper read by Joseph H. Tracy, assistant chief engineer with a leading accumulator manufacturer, before the New York Section of the Electrical Vehicle Association recently. In this paper he pointed out that by lowering the discharge rate of a battery each time it appears to be discharged, considerably more ampere hours can be obtained from it than by continuing at the higher rate. The ability of a storage battery to discharge at a high rate was demonstrated when the speaker short-circuited a 70-amp. cell for several minutes, allowing a short period for recuperation, and then discharged again at a high rate. The current started at about 3,000 amp. and dropped gradually during each discharge.

Carbon Consumption of Electric Arcs.—A paper on this subject was read before the Royal Society recently by Prof. W. G. Duffield, who described experiments to determine the amount of material lost by the poles of a direct-current carbon arc under different conditions of current and arc length. For a given current the carbon consumption of both the anode and the cathode increases with the arc length until a constant value is reached. Using long arcs the consumption per coulomb decreases with increasing current, the ratio of anode to cathode consumption is about 1.5, increasing slightly with the current. The author also concluded that the loss of an atom of carbon from the cathode of a very short carbon arc is accompanied by the transfer between the poles of a quantity of electricity equivalent to four electronic charges, and that in long arcs the loss is due to this essential carbon disappearance plus a quantity due to combustion.

Electrically-Operated Typewriter.—There has recently been placed on the market a typewriter of standard design, which is equipped with special mechanism so that form letters may be written automatically from a perforated paper record or master sheet. The paper records are perforated on another machine provided with a standard keyboard. The automatic typewriter is operated by a 1-20th horse-power electric motor, and if desired the auxiliary mechanism can be disengaged and the typewriter used in the usual way. Thus it is possible to fill in the name and address of the person for whom the letter is intended and then start the paper record mechanism running for the balance of the letter. Further, the mechanism can be shut off at any point and a special sentence or paragraph inserted. Obviously, the work produced by this machine is identical with that produced on the conventional typewriter, hence is accorded the same attention by the recipient as would a personal letter. The new machine is said to write at the rate of 100 words per minute.

Science

A Remarkable Collection of Old Pianos, European and American, including a number of examples dating from the latter part of the 18th century, has been presented to the U. S. National Museum by Mr. Hugo Worch, of Washington, D. C. Seventy instruments have been thus far turned over to the museum, and to this collection will be added several hundred photographs, showing every phase of the pianoforte industry prior to 1850, making a unique assemblage of material on this subject.

An Echo of the "Karluk" Disaster.—The Department of the Naval Service, in Canada, has published in full the diary of Captain Bartlett, master of the Arctic exploring ship "Karluk" of Stefansson's expedition, from July 13th, 1913, when he took command at Nome, to April 22nd, 1914, when he arrived at Cape Serdze, after his hazardous crossing of the sea ice from Wrangel Island and a subsequent journey along the Siberian coast. It also includes a summary of later events, including the rescue of the survivors of his party from Wrangel Island. It is accompanied by a sketch map showing the drift of the "Karluk."

Altitude of the Aurora.—An instructive diagram is published in *Nature* of March 2, by Carl Störmer, which shows at a glance the distribution with respect to altitude of hundreds of auroras, determined by means of simultaneous photographs from the two stations Bossekop and Store-Korsnes, during the aurora expedition of 1913. In all about 2,500 determinations of altitude are shown by dots in one small diagram. Very few dots are seen below the level of 90 kilometers, while a vast majority lie between 100 and 110 kilometers. An extremely small number of altitudes exceeded 200 kilometers, though three appear to have been above 300.

Latin as an International Language.—A letter from Sir Lauder Brunton, recently published in *Nature*, advocating the use of Latin as a living international language, has aroused considerable interest and called forth many comments, of varying tenor, from the readers of that journal. One of the arguments put forth in behalf of this plan (which is by no means a novel one) is that it would reconcile the conflicting claims of classical and scientific education. We are much inclined to doubt, however, whether it would have any such result. A Latin fully adapted to modern needs would probably be so unlike the classical tongue that the humanist would contemptuously disown it.

Subantarctic Cruise of the "Carnegie."—The latest magnetic survey of the "Carnegie" has taken her into far southern latitudes. She left Lyttleton, New Zealand, December 6th, 1915, and the latest letter received from her commander is dated from King Edward Cove, South Georgia, where she arrived January 12th, 1916. During the voyage search was made for Dougherty Island, but although the vessel passed within 3 miles of its charted position it was not visible from the masthead. Captain Ault states that it has either been very much mislocated, or it has disappeared or possibly it was an ice-island. Magnetic observations were made daily, in spite of storms, rain, snow, fog and prevailing cloudy weather.

Qualities That Indicate Hardiness in Apple Trees.—Messrs. S. A. Beach and F. W. Allen, Jr., have recently carried out extensive investigation in Iowa to determine some satisfactory index for distinguishing hardy apple trees before they are old enough to fruit. According to the *Experiment Station Record* the results of these studies as a whole suggest that there is a rather close correlation between hardness of wood and ability to withstand cold, though the variation from this rule is great in some cases. A large amount of stored starch in the pith and medullary rays is another frequent accompaniment of hardiness, as is also large thick petals. The length of season required by the tree to mature the season's growth appears to be the best index of hardiness. None of these features, however, appears to be conclusive.

Studies of Marine Fog made during May, 1915, aboard the ice patrol cutter "Seneca," were described by Mr. P. V. Wells, of the Bureau of Standards, at a recent meeting of the Philosophical Society of Washington. Measurements were made three times daily of the number of persistent nuclei in the air per cubic centimeter, by the corona method of Bdrus. The number was found to be never less than 400, normally 1,000, and on three occasions as high as 50,000. The nucleation was generally high in cyclonic areas, leading to the inference that the nuclei at sea are chiefly salt particles, *i. e.*, evaporated spray. The amount of water in a cubic meter of fog was found, by evaporating the fog electrically and measuring the humidity at the higher temperature, to be 0.7 gram. The fog particles were found to have a diameter of the order of 0.005 centimeter. A rise of 1.4 deg. Cent. in temperature would dispel this fog, and therefore a slight temperature "inversion" resulted in a shallow fog, not extending as high as the masthead.

Industrial Efficiency

Driving Screws by Compressed Air.—A leading American automobile manufacturer has found it advantageous to install a compressed air device for driving wood screws and machine screws and nuts. The compressed air engine can be fitted with any attachment best suited for the work at hand. It is reported that a saving of 75 per cent in labor cost over the usual manual operation has been effected by the installation.

Industrial Preparedness in Holland.—Industrial preparedness for the Netherlands is being advocated by the *Netherlands Exportblad*, published in Amsterdam. It calls attention to the great extent to which the Netherlands has been dependent upon the manufactures of other countries and recommends that trade guilds be formed and presided over by practical experts in machine building, shipbuilding, paper making, brewing, and other lines, where the youth of the country may be trained to these pursuits.

Increasing Motor Truck Efficiency.—In a recent issue of *Factory* a contributor suggests a simple yet most efficacious method of securing greater service from any motor truck. He recommends the use of a number of crates or tubs, which can be loaded at any time and handled by a derrick which places them on and removes them from a motor truck. Thus the motor truck becomes practically independent of loading operations and the minimum of time is spent in loading and unloading. If a trailer is used in conjunction with a motor truck this system of loading is even more effective.

Cigars and Cigarettes—and Fires.—During the past year it is reported that there were 1,306 fires caused by cigars and cigarettes carelessly thrown away in New York alone. The average loss per fire during 1914 was a little over $569, and if each fire resulting from cigars and cigarettes and other similar causes should equal this sum the total loss due to carelessness would be about $743,114. Carelessness with matches during the year 1915 resulted in no less than 1,314 fires as against 1,248 such fires in 1914. Ordinances have been put into effect in New York with a view to lessening the number of fires arising out of carelessness.

Government Employees Edit Magazine.—Once a month it falls to the lot of employees in one of the nine bureaus of the Interior Department of the National Government who are members of the Home Club of Washington to edit *The Home Club Bulletin*. The March issue, for instance, has been edited and published under the supervision of members in the U. S. Patent Office and contains 24 pages devoted to subjects of particular interest to members of the club. Aside from the pleasure which the employees of the Interior Department find in this new task, the change which it affords them from their routine work may well be considered of material benefit to them.

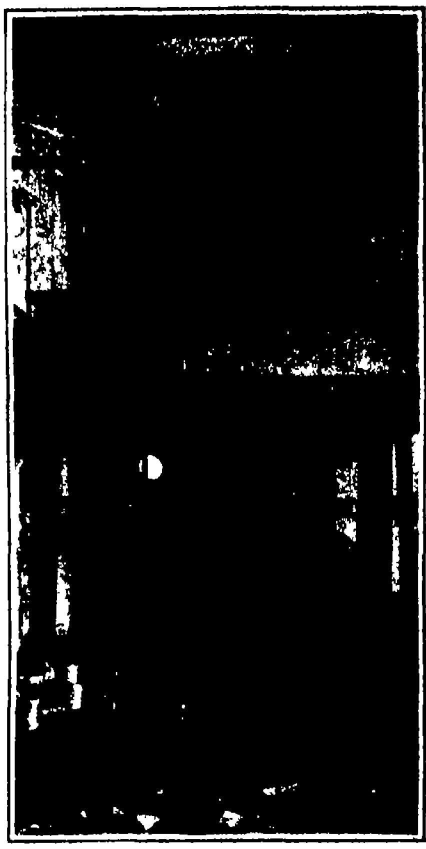
The Phonograph as an Industrial Coach.—There exists a dry cleaning establishment in Cincinnati, Ohio, that gives its employees music at frequent intervals, with the object of speeding up the workers. There are some 300 workers in the plant, and the firm has installed a sufficient number of phonographs to provide music for them all. It is reported that in the pressing room the girls swing their irons over the work to the tune of popular marches and songs, and that much of the monotony of the work is eliminated by the music. The manager of the plant states that this novel idea in industrial efficiency originated in South America.

Corrugated Cardboard Boxes vs. Wooden Boxes.—Because of their many advantages over wooden boxes in the shipment of small articles corrugated cardboard boxes are rapidly replacing the former. Although the cardboard boxes are strong enough to withstand heavy pressures they weigh considerably less than a wooden one of the same size, hence they effect an appreciable saving in express or freight charges. Furthermore, the cardboard boxes, because they can be folded flat and stored in that shape until used, occupy but little space. As a typical example it is reported that 1,000 cardboard boxes have been stored in a space which formerly accommodated but 200 wooden boxes of the same capacity.

Fuel Conservation on Railroads.—Writing in the *Rock Island Employes' Magazine* recently D. B. Sebastian discloses a number of interesting facts regarding the huge coal consumption of this representative American railroad, as well as the vast opportunities for economy and careful methods of handling in this branch of railroading. He states that the Rock Island railroad annually requires approximately 100,000 cars of coal to operate its trains. The fuel bill for the year 1915 was $6,531,592. One shovelful of coal saved out of each ten shovelfuls, which is not a difficult or impossible achievement in view of the existing wasteful methods of firing locomotives, would effect an annual saving of $653,159.20 without impairing in any way the efficiency of the railroad.

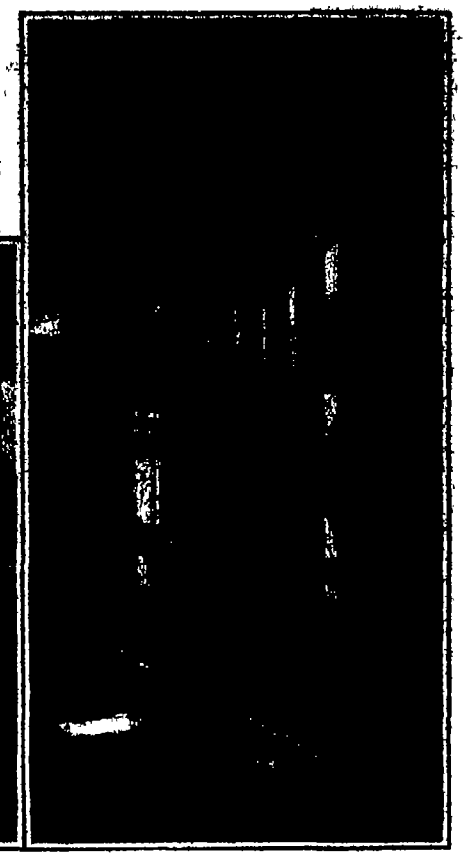
The Problem of Gasoline Supply

Review of Present Conditions and a Forecast of the Future



Arrangement of a small, single-tube furnace in the first experimental plant of the Rittman process

Laboratory at the development plant, showing the type of distillation apparatus used in testing cracked oil. It is imperative that the oil produced be tested at frequent intervals



Arrangement of condensers for multiple tube furnaces in an installation of the Rittman process

THE widespread and practically universal use of stationary gasoline engines automobiles, farm tractors *motorcycles and numerous other gasoline consuming ma*chines renders any limiting or restricting of the motive agency however it may be brought about, of great if not vital interest to practically everyone So it is that the increased cost of gasoline presents a serious problem to automobiling from the standpoint of the manufacturer all the way down the line to the ultimate consumer

Conservation of the gasoline supply truly strikes the very heart of the entire automobile and allied industries It comprehends not only the initial seeking for the treasure, but also the ultimate use of the refined product Thus it begins with the drilling of the wells for the crude petroleum and extends throughout the industries even to the necessity of collecting statistics covering the petroleum and gasoline demand so as better to enable the producer to control his output in accordance with market conditions Conservation also comprises the careful usage of the refined product and *the avoidance as far as possible of wastage in the* consumption of crude oil where other heating mediums can be utilized instead

Within the limits of this article it is difficult to discuss in a technical way all of the problems that confront one seeking the conservation of gasoline Consider for instance the opportunities of improvement in the production of the raw material Existing processes of extracting oil from the earth leave much oil in the sands This loss is still further increased if the wells are not properly drilled and cased to exclude water

Prior to the entry by the Bureau of Mines of the Oklahoma field it was considered impossible to drill oil wells *through high pressure gas sands without wasting* the gas As a consequence, in the development of the Cushing field less than 10 per cent of gas has been utilized and the remaining 90 per cent of gas which is allowed to go to waste is estimated conservatively to be worth $15,000,000 Obviously, there should be a rare opportunity for improvements tending to better the drilling of wells and the subsequent handling of the oil and gas There are also opportunities for improvement in connection with the storage of oil to prevent or lessen evaporation as well as in the separation of the oil and the gas where the two occur together under high pressure, by means of traps or other devices which would permit the recovery of the gasoline before the gas is used for fuel purposes.

The Bureau of Mines among other things, suggests a stoppage of the wasteful burning of petroleum under boilers It also discourages the use of crude oil in the making of artificial gas It recommends in no uncertain *words the discontinuance of the practice of burning oil* in cases where substitute fuels are available The waste not only of oil but also of natural gas, believed to be readily preventable, now exceeds millions upon millions of dollars annually This waste is not only incident to the loss of petroleum as a result of mixture with water and the loss incident to prematurely abandoned wells, but also to the tremendous waste from gushers and other sources of supply difficult to control under existing systems of operation

The Secretary of the Interior has suggested in a communication to Congress several ways of relieving the situation, such as the use in internal combustion *engines of heavier distillates approaching kerosene* and involving the use of a successful kerosene carburetor He also urges the general use of cracking processes by which gasoline may be produced from kerosene and other less valuable petroleum oils, apart from the quantity of gasoline already distilled from the original mineral oil Views of an installation for treating oil by the Rittman process accompany this article. Details regarding the process appeared in the March 20th, 1915 issue of the SCIENTIFIC AMERICAN Another of his suggestions is the development of gasoline substitutes, such as benzoin, and the utilization of oil-shale as an alternative source of gasoline While it is true that the development of the gasoline engine as used in motor vehicles has had for one of its features the steady increasing of the mileage per gallon, still this has failed to prevent the steadily increasing demand due to the enormous increase in the production of motor cars.

Students of the subject are realizing more and more the importance *of some reliable collection of statistics* relating to the entire field This is accomplished, in a way, by several departments of the Government, including the Geological Survey, the Federal Trade Commission, the Census Bureau and the Bureau of Mines. It is believed, however, that the time is near at hand when some bureau of the Government will be especially charged with the reliable collection of statistics and the publication thereof, so that they may be readily available to all interested in the industry

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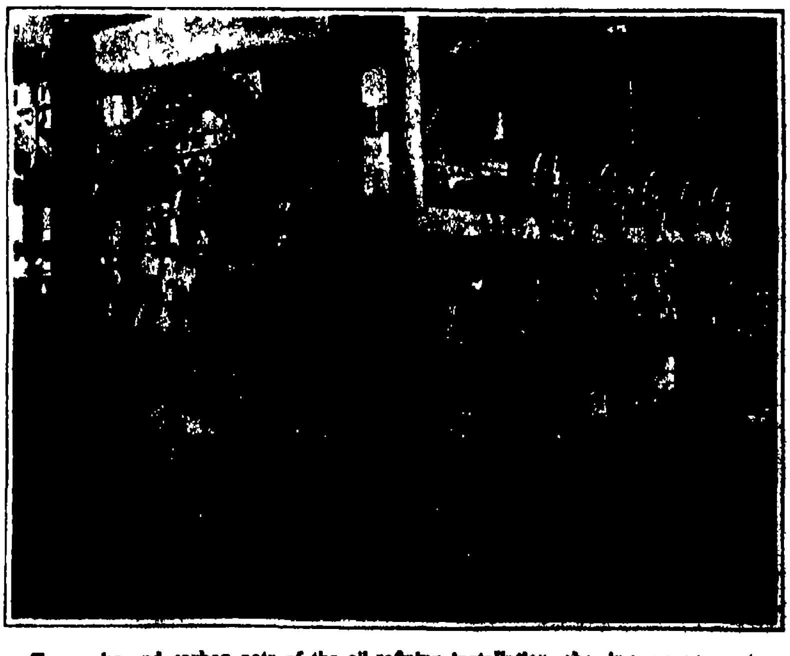
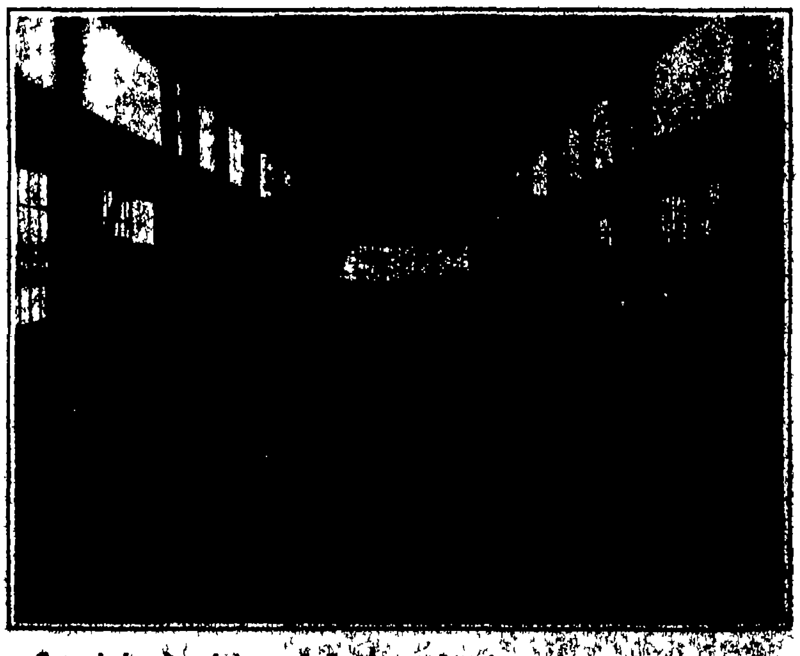


Tar necks and carbon pots of the oil-refining installation, showing arrangement of gate valves



General view from balcony of oil [illegible] valves in an oil- [illegible]

Section of the roofed-over tracks at west 145th street showing a ramp leading to the motor boat basin

Typical section in the neighborhood of west 42nd street, showing connection with the proposed new piers

Proposed Improvement of New York's Hudson River Front

Eliminating Railroad Operation at Street Grades

NEW YORK CITY has had occasion to regret sincerely the granting of a franchise to the New York Central Railroad, many years ago, for a street level line down the west shore of Manhattan Island and through the busy section of the city to St John's Park It has been paying in blood for this hastily given franchise. The yearly death toll has emphasized the pressing necessity of eliminating the railroad from its street grade Aside from this, the railroad has proved an eyesore along the beautiful park sections lining the Hudson River Riverside Park might more properly be called Railroadside Park, for it is separated from Hudson River by lines of car filled tracks

For some time efforts have been made to remove the objectionable features of the line In the SCIENTIFIC AMERICAN of May 6, 1911, we published plans then proposed for running the tracks of the New York Central Railroad underground through Riverside Park and providing elaborate dock facilities near the lower end of the park, which would facilitate the handling of freight between rail and steamship lines and across the river to the railroad terminals in New Jersey

A far more satisfactory plan has just been made public by the Board of Estimate's Committee on Port and Terminal Facilities and public hearings are now being held on the plan It provides for putting the tracks underground through the park and residential sections and placing them on an elevated structure through the commercial sections This will give the city a practically continuous parkway from 72d Street to Spuyten Duyvil, with no unsightly railroad line to mar its beauty Riverside Park will be extended to the river front throughout its entire length, and there will be no commercial exploitation of the shore line Even such piers and structures as now exist will be reduced or removed altogether

Below Spuyten Duyvil, Inwood Hill is to be converted into a park The Harlem ship canal will be crossed by a new swing bridge connecting with tracks that pass into a tunnel through Inwood Hill Within the covered section from 151st Street to 183d Street the railroad will construct a freight yard Manhattan Street will be crossed by a viaduct, and the tracks will then plunge underground again through the Riverside section. At 59th Street the line will emerge from the ground and be carried on an elevated structure for the rest of its course down to Canal Street where a new terminal is to be built Connection will be made between 59th and 42d Streets with the proposed new piers, the trains entering the piers on an upper level Provision is made for the city to build two tracks paralleling the New York Central tracks from 59th Street south to 30th Street using part of the Central's structure A marginal way is also allowed on the west side south of 30th Street for the construction of a municipal railroad terminal South of West 30th Street the New York Central lines will run through a private right-of way and will be completely screened from view except for street crossings

Between West 39th Street and West 30th Street where the railroad now has a large yard provision for entrances into the upper story of the reconstructed 30th Street yard has been made This line will be kept sufficiently inshore to allow the lengthening of all piers between 41st Street and 30th Street to 800 feet

The West 30th Street yard which covers the area from West 37th Street to West 30th Street between 11th and 12th Avenues and several additional blocks west of 11th Avenue will be also entirely rebuilt with great incidental advantages to the city The railroad plans to build a double deck freight terminal designed to handle immensely increased business At present three streets are entirely closed to traffic and the remaining streets in the section are crossed by dangerous surface railroad tracks According to the new plan all grade lines east of 12th Avenue are to be eliminated and streets now closed are to be opened to the water front

The main cost of this great engineering undertaking will be covered by the New York Central Railroad According to the report real estate valued at about $11 000 000 will be transferred to the New York Central, which will be offset to a large extent by the transfer of real estate valued at about $5 000 000 to the city However, most of the city's contribution consists of sub surface easements and rights to cross streets on a slightly elevated structure and similar grants of comparatively little value to the general public whereas the benefits it will receive from the real estate transferred by the railroad will be of value to the whole city

The city will make no money contribution whatever

(Concluded on page 494)

Section through Riverside Park above Grant's Tomb showing how the park will extend over the New York Central tracks to the river

Strategic Moves of the War, April 28th, 1916

By Our Military Expert

One of the great surprises of the war resulted from the landing last week of Russian troops in France. No positive figures as to their number have been available, but it is estimated that the force consisted of approximately 20,000 men. A second expeditionary force is reported as landed in France.

From seemingly authentic sources it is also reported that the Russian government contemplates placing at least 250,000 Russian soldiers upon French territory within a few weeks.

If this be true it furnishes considerable food for thought. The sailing of the expeditions had been kept a profound secret except to the members of the *Entente* general staffs and much speculation as to the exact meaning of this feature of war's development resulted. The consensus of opinion of military observers, founded upon the slight data available, was that Russia wished to demonstrate her full allegiance to the Allied cause.

Some observers, principally of Teutonic sympathies, professed to see an indication of French weakening, for they argued:

"France has lost so many men that she has been compelled to draw on other resources to supply her losses."

This on the face of it is out of the question. France with at least 3,500,000 men available for service occupies not more than two thirds of the western line, the British having taken over the remainder to some distance south of the Somme River, thereby releasing French troops for service at Verdun.

There is, however, a larger and more significant aspect to the case. Russia's hordes are countless, far in excess of what her munition factories can now equip. As France and England are in a much better case, so far as equipment and its manufacture is concerned, they are naturally desirous of aiding their Eastern ally in every way by sharing their resources with Russia.

Report has it, then, that arms, equipment and munitions are to-day assembled in France for these Russian troops. Instead of sending these supplies into Russia through Archangel or Vladivostok, both of which ports are extremely distant from France and inaccessible as well, Archangel being held in a grip of ice throughout the winter, it is far easier to equip these men in France. Comparative paucity of railway service in Russia renders the handling of such imports difficult in the extreme.

The greatest significance of this movement, however, is that it seems to indicate the probable course of *Entente* action in the near future.

If Russia does send this powerful army of men to the west, deduction is forced upon one that the main effort for decisive action in the war will take place on the western line.

Verdun has demonstrated the character of the deadlock which exists in this theater of war. With magnificent courage, determination and impeccable military skill, Germany has hurled her legions fruitlessly against a rock like defense.

After the first weeks of the Verdun assault wherein considerable ground was conceded by the French because the higher military authority had decided not to defend the salient east of the Meuse, moral and political considerations caused a reversal of military policy; and at the eleventh hour of the defense it was concluded that the line east of the Meuse be held.

The outcome to date speaks for itself. The French line has scarcely been dented since this decision was taken. It now seems as though Germany had bent every military resource in the attempt to gain a decision at this point, and it also seems almost a foregone conclusion that Germany cannot break the French line here. France opposed Germany with between one third and one half the number of troops that were engaged in the assault, the losses of the latter were absolutely appalling.

Therefore, Germany's efforts have gained practically nothing but the admiration and respect of a fascinated world, in tribute to her magnificent organization and the wonderful fight she has put up.

With the lessons of the Verdun attack fresh in mind, fully digested by the allied general staff, it is easy to see, and reasonable too, why even the millions of troops possessed by France and England should be re-enforced by contributions of men from their eastern ally. Every indication points to the launching of an enormous offensive by the *Entente* some time within the next few months. To be of any value this attack must be made on a titanic scale, and the losses which such an attack must sustain must be measured by the losses Germany has experienced at Verdun.

If any such gigantic attack is to be made there must be *sufficient men* available for immediate service, a portion to remain effective for carrying an attack through many successive lines of trenches after deducting the stupendous losses which must accompany it. If this attack be launched on the front of, say a hundred miles, allowance must be made for losses averaging 20,000 men a mile of front—a total of 2,000,000 stricken men. And other millions must remain available, organized, to hold and consolidate the positions won at this awful cost. Russia's quarter of a million effectives in France may therefore really constitute, with their brothers of the west a resigned sacrifice on the altar of Mars—"Ave Cæsar Imperator."

There has been much speculation as to the whereabouts of England's acknowledged 4,000,000 men under arms. While the British have taken over a considerable sector of the French line in addition to their occupation of the Flanders front, an observer but recently returned from abroad reports with reasonable authority that there are no more than 1,500,000 British troops upon the continent. A scattered few are in Mesopotamia, Egypt, and in other portions of Africa, a more numerous body is within the lines of Saloniki. This leaves a force of at least 2,000,000 men in England to-day, undergoing and having undergone an intensive course of military training. This same observer says that it is generally known abroad that this British force is being held in hand solely for the launching of the grand offensive. France has classes not yet called to the colors, while there are enormous bodies of organized, trained troops in France to-day which have never fired a shot in this war, they, too, are being preserved for the offensive.

It is common knowledge that the losses must be absolutely staggering when "The Day" arrives. There will probably be need of every available man, and Russia seems to be supplying her quota for the slaughter, in addition to maintaining her own individual lines on the eastern front and in Asia Minor.

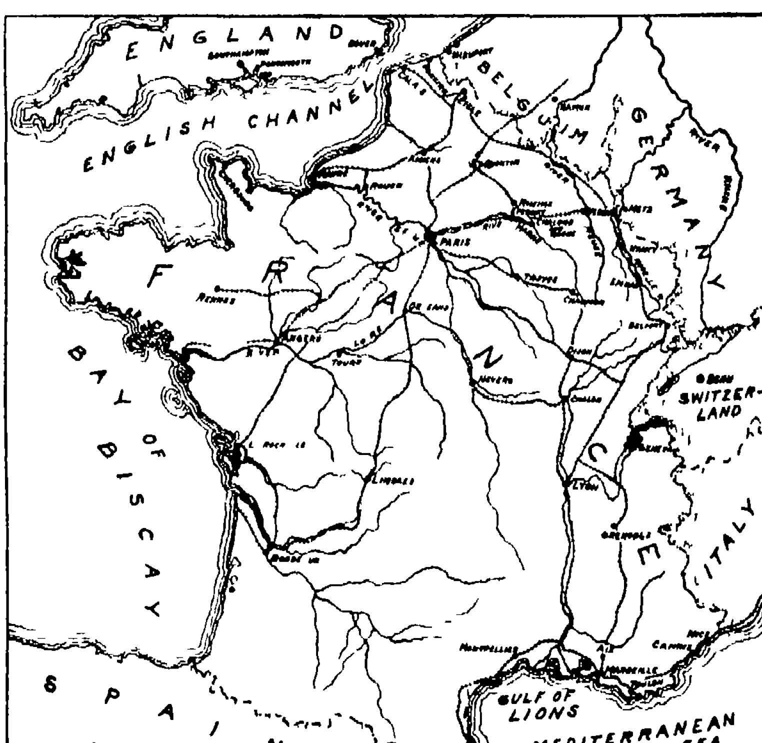
It has occasioned considerable surprise that Russia was in such condition that these men could be spared. The deduction is forced upon one that her circumstances must be even better than currently reported. With a time-distance between Russia and France, via Vladivostok, of over a month, by Archangel somewhat less, the detachment of Russian troops is irrevocable. There can be no calling them back should Russia herself need aid, for, if any such crisis threatened, it must culminate before they could be shifted. The fact that Russia is sending troops to France, therefore, does little to offset the great advantage of interior lines which the Central Empires possess.

It is impossible for the *Entente* to shuttle troops backward and forward with anything like the ease and effectiveness which Germany has enjoyed. The German military railway system, while but a unit in the practically perfect military machine, has been the key to Teutonic success to date.

To help render this advantage less great—it cannot be voided—it seems imperative that when an allied offensive is undertaken, it must be assumed on every front, that troops may not be detached and massed by the Germans at will.

Spring, with its weather benevolent to military operations, is almost here, and the auspicious time for such an offensive seems near at hand. The eastern lines are still held immovable by the thaw, this is the condition which has safeguarded Germany in detaching powerful forces from the eastern lines to use against the west. But if reports as to Russia's "come-back" are true, the day is not far distant when the eastern line must be occupied in force to withstand assault. The tremendous *Entente* forces at Saloniki are not held there for amusement. The comparatively recent conference of the Italian Generalissimo with the Allied Powers That Be, with the summoning of additional Italian classes to the colors, seem to imply that at least there will be no abatement of activity on the Italian line. These are necessary concomitants to assumption of the offensive in France.

The coming of the Russians to France, therefore, seems to herald activities in the near future on a scale greater than ever before.



Where French, British, Belgian and Russian troops are striving to reach a decision with the Teutonic Allies

The Current Supplement

Those who last year read the lectures of Sir J. J. Thomson on Atoms and Ions, before the Royal Institution, will be pleased to learn that this noted scientist has delivered another important series of lectures in which he sets forth modern views on physical science in the same lucid manner which has made his previous discourses so popular. The subject of the present lectures is *Radiations from Atoms and Electrons*, and the first appears in the current issue of the Scientific American Supplement for May 6th, No. 2105. An important enterprise of the Department of Agriculture for the benefit not only of the farmer, but of the public as well, is described in *Reducing Our Waste in Eggs*, which is accompanied by explanatory illustrations. *Aeroplane Struts* describes and illustrates various methods of making these important parts of flying machines. *The Bagdad Railway and the European War* gives valuable information on a subject about which there has been much inquiry of late. *Teaching Scientific Forestry* tells of the valuable work done by a state institution in conserving one of our most important natural industries. The article is profusely illustrated. *Great Electro Magnets* gives many details and much information about a wonderful instrument proposed for the University of Paris, and it is accompanied by numerous diagrams. Other important papers in this issue are *Physical and Mechanical Factors in Corrosion*; *The Effects of Electrolysis on Underground Piping Systems*; *The Food Supply of the German People*, *Sunlight a Necessity for the Maintenance of Health*, *The Transport of Material in the Form of Dust* and *a Mechanism of Protection Against Bacterial Infection*.

Periodical Devoted to the Study of Soil

With the January, 1916, issue, a new publication known as *Soil Science* and devoted to problems in soil chemistry, soil biology and soil physics has made its initial bow. While it is admitted that scores of technical papers on the various phases of soil fertility appear in the course of each year as station research bulletins or in publications devoted to chemistry or agriculture, it is claimed in an introductory note appearing in the first issue of Soil Science that under existing conditions the soil investigator is put to much inconvenience in keeping before him all the most important papers on soil research. In the present publication it has been aimed to gather within its covers each month the results of soil research.

Soil Science is published by Rutgers College, New Brunswick, N. J., under the editorship of Jacob G. Lipman.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Stream-line Bullets in Flight

To the Editor of the SCIENTIFIC AMERICAN

In your paper of April 8th I notice that Major Alston Hamilton, of our Coast Artillery Corps, makes the statements "There is now a tendency to still further modify the shape of the projectile by employing other curves than simply circular arcs for the head, and, in addition, tapering the rear portion of the projectile" And "Tapering away the rear portion of the projectile materially reduces these eddies, but, if carried to extremes, it would cause the flight of the projectile to become very erratic"

I wish to call attention to the fact that this last statement does not conform to the laws of nature, or with what has been learned by aerostatic experiments, which have shown conclusively that the true stream line shape, such as nature has given to birds and fish is the proper shape for swiftly moving bodies through both air and water It is therefore plain that the true stream line shaped bullet and projectile, which of course, would have to be used in combination with a gas check cup or wad, is what we will have to come to, to get the minimum air resistance The metal gas check wad, concaved in front to fit the tail end of the projectile, should hold it straight and true while pushing it through the rifling, and there is no reason to believe the projectile would fly erratically It is conceded that the projectile would fly with greater velocity, *then it would hold its spin longer, and after* spending would light head down

Experiments made by Hiram Percy Maxim in trying to produce a noiseless flight bullet show that the "whip lash" crack is caused by the front end of the bullet, which is a bow sound wave In a letter I received from Mr Maxim, written last November, he says "We made bullets tapered at both bow and stern We found that they made the same crack noise that the *flat stern bullet made Apparently the bow wave is* the cause of the bullet's flight noise, and the shape of the stern of the bullet will simply *affect velocity of flight* I believe we have a right to expect from the 'cigar' shaped bullet the advantages which you mention. I would not be at all surprised to see such a shape come into use for certain purposes There is no hope, however, that such a shape would have a silent flight when the velocity exceeds the velocity of sound"

Mr Maxim has likely done more experimenting in a systematic and intelligent manner in this line than any other one in the United States Yet it seems that he went no further than the so-called "cigar" shape He, however, had tackled only the problem of noise, and not velocity Yet he made gas check cups and "cigar" shapes, and found that there was an improvement in velocity Now, since velocity is what we need *for range, the air resistance is hereby solved as far* as we can solve it. I know of no experiments which show that a true stream line bullet or projectile, with a carefully formed gas check cup, will fly "erratic," and cannot understand how such a conception could be gained, unless cups that collapsed were used in such experiments In such cases the cup might pinch the tail of the bullet too tightly to drop off easily and evenly after leaving the barrel, or a too lightly constructed cup would not hold the tail true while passing through the barrel If, however, available for your publication, it would be timely as well as interesting for you to procure from the Government information as to these experiments. It would be interesting to know why the true stream line shaped projectile would not be an advantage, since that shape greatly reduces resistance, and it is admitted that the semi stream-line or "cigar" shape is decidedly advantageous.

ELI E GREGORY

Central City, Ky, April 18, 1916

The National Guard Problem

To the Editor of the SCIENTIFIC AMERICAN

Referring to your editorial in April 15th issue it seems to the writer that you are wrong in your main contention.

If Congress has been influenced in its action on the Hay and Chamberlain bills by fear of the political power of the Organized Militia, it has been scared by a mere "bug-a-boo." The power of the National Guard at the polls lies in the votes of the enlisted men and lower commissioned officers who make up all but a small part of its numerical strength.

The attitude of these men toward public matters has always been, and always will be, that of all other patriotic citizens. Each votes according to his conscience and they do not vote as a unit. As far as matters of defense are concerned, it is the writer's belief that if a poll of the Guard were taken, the vast majority would be found lined up in favor of universal compulsory service No one realizes more acutely than a guardsman that he is training himself and making sacrifices while the other fellow is taking his ease and in many cases amusing himself by slinging mud at the guardsman into the bargain. It, therefore, seems unfair to deny the militiaman a degree of public spirited ness at least equal to that of the average citizen out side of the Guard.

That the National Guard is deplorably inefficient in some states is no reason to decry its entire personnel No one will contend guardsmen least of all, that the Militia system as it exists is the best for National defense. It should not be forgotten, however, that the men in the Guard have been working for years without any reward and it may be stated as a further fact that they would continue to do so regardless of any action that Congress may take They have been striving to make as good a force as possible under the system as it existed In some states they have succeeded much better than in others and it may reasonably be believed that under proper Federal control they all might approximate an equal and a higher standard of excellence Is it not conceivable that Congress may have been impelled to its action by a belief that the Guard could be thus improved by paying its members and then demanding from them in return uniform effort and definite results in all the states? Such a conclusion is at least as plausible as that which holds Congress to have been dragooned by a money hungry National Guard with its phantom political power

The writer is open to the charge of prejudice, having been a member of the National Guard of New York State for over six years. My opinion is therefore largely based on knowledge of those officers and enlisted men with whom I have been brought in contact I give it for what it is worth The members of the National Guard of New York or any other state would never be found voting en masse for the furtherance of any measures against the country's welfare even though a few dollars of pay were doled out to them

CHAS N MORGAN

357 1st St Troy N Y

Possibilities of the Transatlantic Flight

To the Editor of the SCIENTIFIC AMERICAN

Having noticed in your current issue a note telling of the second attempt of Messrs Curtiss and Wanamaker to cross the Atlantic in a single flight in a huge triplane of the former's design and construction, I am writing you in order to point out the fallacy of this undertaking and to show why the project is an impossibility at the present stage of development of aviation

From newspaper articles it is understood that a new attempt will be made to cross the Atlantic in a continuous flight of 30 hours' duration Without technicalities, I propose to show undeniable figures from the leading accomplishments in aviation up to the present time that the contemplated continuous flight is hardly possible as yet

What is required to be known is the weight resistance, and speed of the machine With these data it is immaterial what size machine is constructed, so long as it is built upon aerodynamic lines It is a recognized fact that the average machine does not weigh less than 11 pounds per horse power, also that no practical aero motor has as yet been constructed that uses less than 0 6 pound of fuel and oil per h p hour and that the resistance at a speed of 70 miles per hour of any machine built for the contemplated flight could not possibly be less than one sixth of the weight Using these figures, we arrive at the weight per horse power as follows

Fuel for 30 hours	18	pounds per horse power
The machine	11	" "
Pilot, etc	1	" "
Total	30	" "

The resistance of 1 lb is equivalent to 5 pounds per horse-power, and as 1 h p represents 375 mile-pounds per hour, the resistance of 5 pounds would be equivalent to only 350 mile-pounds per hour, or 94 per cent of 1 h p, which is in excess of any propeller efficiency.

Allowing for the reduction of weight from consumption of fuel and oil during flight, the mean resistance due to fuel can be reckoned as half, or 9 pounds, causing us to get 3.5 pounds in place of 5 as the head of resistance of the entire machine, which equals at 70 miles per hour, 245 mile-pounds, or 70 per cent of 1 h p

These figures prove conclusively that the non stop flight across the Atlantic is beyond the present possibilities, and this is further proven by the fact that no machine thus far built has demonstrated that a speed of 70 miles per hour has been possible under the above conditions.

With the data given I challenge any one to show a margin sufficient with which to accomplish the proposed flight This can only be done when motors are developed having considerably less oil and fuel consumption and with the resistance materially reduced.

It is inconceivable to me that any person having even a slight knowledge of aerodynamics would lend their names and indorse such an undertaking and it is small wonder that this Government is cautious in following the many suggestions and proposals put to them by some of our aero institutions

GEORGE LANZIUS

New York N Y

Galveston's Seawall

To the Editor of the SCIENTIFIC AMERICAN

In your issue of January 15th page 76 under the subject of "Protecting Galveston's Seawall you published some statements with reference to the storm of last August and its results which we feel sure were made without a full knowledge of conditions and which do a gross injustice to this community

You say "Prior to the storm, which destroyed millions of dollars' worth of property and cost hundreds of people their lives," etc The property loss to Galveston nowhere near approached a million of dollars The loss of lives within the protected area of the city of Galveston was six and none of these need of necessity have been lost had the people exercised even due diligence

You say further "The force of the storm entirely destroyed the beach which is gradually rebuilding, however, and lifted the huge rocks clear of the seawall and hurled them in some instances across the boulevard —just inside the seawall 100 feet wide" No such instance as this happened

The rest of your story is interesting from a mechanical or engineering standpoint, and had it not been for these few lines in your story it would have been entirely satisfactory but these few lines, giving to the world as they do an exaggerated idea of the situation, are detrimental to our community and you will agree is an injury, which I am quite sure was not intended

Although a great deal of relief was offered by outside sources at the time of this storm, Galveston declined all such relief, and among her own citizens subscribed and collected sufficient funds to take care of all the relief of a public nature that was necessary at that time Twenty two thousand dollars was thus expended, and, of course in cases of this kind there are always more or less unworthy cases that obtain a portion of the relief

It is true, as a whole there were millions of dollars worth of damage done, because the storm extended as far north as Chicago, and it did more damage in Newport Ark, and cost more lives in that immediate vicinity than it did in Galveston It is also true that there were a great many lives lost if you will consider the storm in its entirety and include all of the territory that it affected, but the manner in which your article is written leaves the impression that this tremendous loss of property and life was occasioned in Galveston and it is with a view to correcting this impression with you and possibly for you to correct it to your readers that we are addressing you this communication May we have the pleasure of hearing from you?

H H HAINES
Secretary and Traffic Manager of the Galveston Commercial Association

Galveston, Tex

Hints for Exporters

To the Editor of the SCIENTIFIC AMERICAN

As a rider to the letter of Mr E Anderson on South American trade, which went into details

Business men of the U S A. who would acquire a clientele in Down America should remember

That the American expressions Do It Now, We Should Worry etc, etc, apply only in the U S A

That foreign customers expect you to do business their way

That business in Down America is done by the formula American way multiplied by 1x2x1x4

That profits are based upon the equivalent of our quarter-dollar the world over You get nearly as much as by the dollar system

That you can meet every requirement of this trade if you only will really try

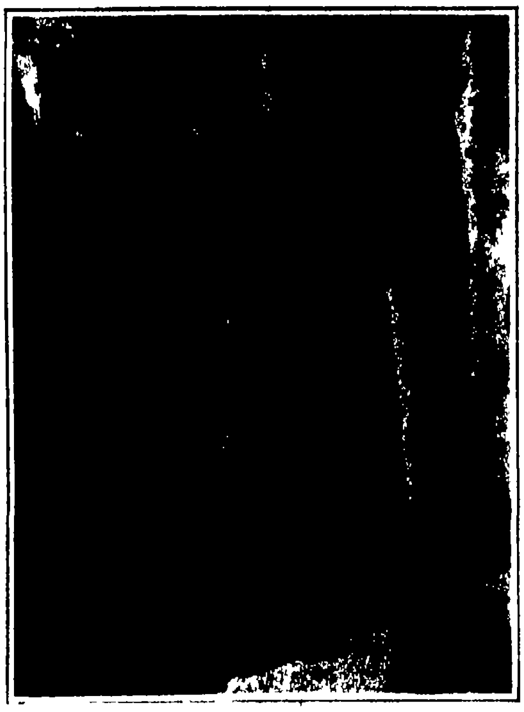
That you have every resource, ability, and equipment of the U S A at your back

And that only tact patience and thorough study of your subject are necessary

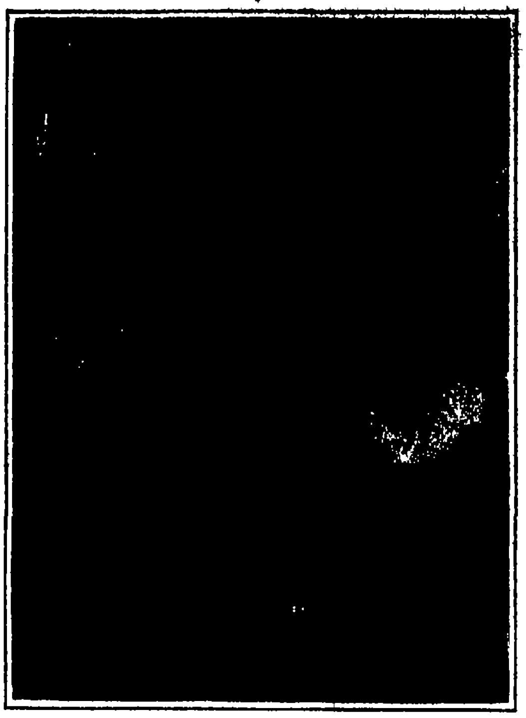
Your legislation, merchant marine, credits etc, will follow you, only really try

H M HOFFMANN

Brooklyn, New York



A corner of the miniature cave, with a large stalagmite pillar rising from the floor



A member of the Museum of Natural History staff preparing the miniature cave

Central section of the miniature cave, showing the terrace-like formations

Building a Cave at the American Museum of Natural History

By Walter L. Beasley

A MOST realistic and instructive cave reproduction is now being finished for the Geological Hall of the American Museum of Natural History New York It is a miniature of a remarkable newly-discovered grotto just explored in Weyer's Cave, Virginia

The cave reproduction is faithful in every detail, which makes it at once an impressive and graphic representation of the original one It is replete with beautiful and fantastic formations of stalagmites which have been carefully removed from the natural cave and transported with great difficulty to the Museum, where they have been assembled in their exact order of occurrence Thus, as a result of the arduous tasks involved the cave may be considered as having been virtually transplanted from its natural surroundings to the Museum; where it can be viewed and studied by the visitors.

The facsimile cave, representing as it does the most advanced and up-to-date type of museum exhibits which impart scientific knowledge in an unusually interesting and efficacious manner is destined to prove of exceptional educational and popular interest The author through the courtesy of Dr Frederick A Lucas, Director of the Museum, was afforded the opportunity of securing a series of advance photographs of the artificial cave scenes, which are here reproduced These views represent the main features of the finished interior of the grotto, which occupies a space seventeen feet long fourteen feet wide and eleven feet high

The design, the construction of the artificial grotto, and the arrangement and setting of the many stalagmites have been skillfully performed by William B Peters of the Staff of Preparation Over a year of critical and painstaking labor has been devoted to the careful setting and assembling of the numerous stalagmites forming the interior

Mr Peters, along with an assistant, visited Weyer's Cave in Virginia in order to accomplish the difficult and somewhat dangerous task of dislodging and removing the weighty formations found on the floor and suspended from the ceiling of the cave chamber This unexplored grotto forming the original of the museum exhibit, when opened up was found adorned with a wealth of magnificent yellowish red stalagmites and

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An Ice Mine That Freezes in Summer and Melts in Winter

By Charles Arthur Vandermuelen

UNBELIEVABLE as it may seem, there exists at Coudersport, Pennsylvania, an ice mine. It was discovered some 18 years ago by a farmer who, noting a peculiar coldness—even in the warmest weather—of a certain portion of his farm, was led to dig there in the belief that he would find a deposit of silver The mine or cave which he unearthed proved to be 40 feet deep and from 10 to 12 feet in diameter At present, it is entered by means of a ladder, since it is situated on the side of a hill

Geologists are not able to explain why the mine happens to be where it is, nor why the ice should form, in seeming opposition to the laws of nature, in summer and melt in winter, as it does in this instance. The ice is formed from a peculiar cold mist which comes through openings found all the way from the top to the bottom of the 40-foot shaft. As soon as warm weather arrives, frost appears on the walls of the shaft and soon tiny icicles form rapidly, until in the warmest weather huge icicles, often 2 feet thick, reach from the platform, at the top, to the bottom of the mine The ice begins forming in May, and in October the thaw sets in

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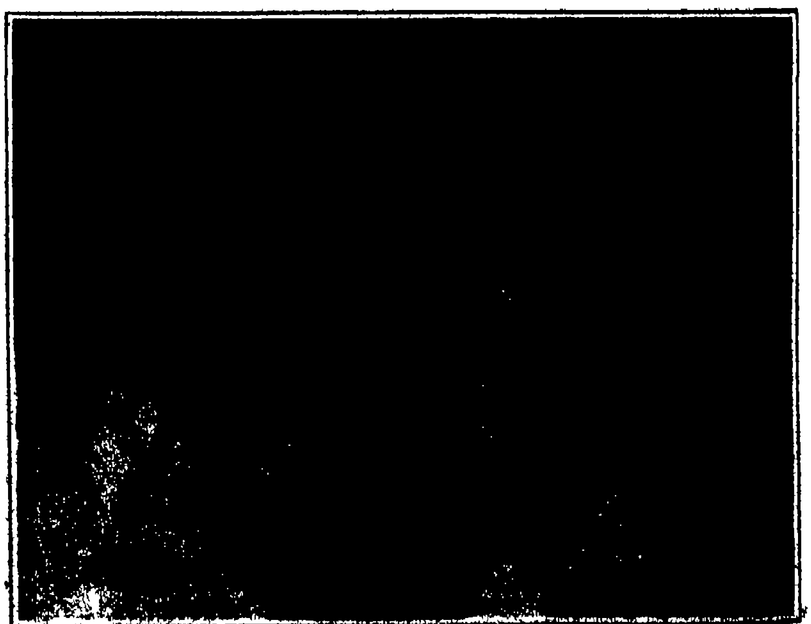
A downward view in the ice mine shaft, showing the huge icicles formed during the summer months

Entrance to the ice mine. The ice forms most rapidly in summer and melts in cold weather



A section of the ice mine shaft, which is 40 feet deep and 10 to 12 feet in diameter

Taking a motion picture of blood circulation in a frog's foot. The light is passed through the subject into the camera lens

The technique of taking motion pictures of blood circulation in a frog's foot, showing the arrangement of the apparatus

The Frog as an Entertainer in Motion Pictures

THE frog has always been a generous contributor to science, his foot having been observed by physiology classes for generations as a visual evidence of the circulation of blood. Advancing with science, he has broken into motion pictures and reel after reel of film showing the red and white corpuscles chasing merrily up and down in the web of his foot will now lend new interest to the physiology lesson.

Micro-motion study of the circulation in a frog's foot has been carried out as a part of the medical research work of a Michigan sanitarium. The object was to provide a graphic demonstration of the principle of blood circulation and also to determine the effect of a large number of therapeutic measures upon circulation. In both these objects success has been reached through the use of an everyday motion picture camera and a high power microscope, a mercury lamp being used for illumination. Mechanically and photographically, the combination produces excellent results; and it is not even necessary to pin the frog's foot to the finding board, a fastening of adhesive tape being sufficient for the purpose.

The pictures obtained have proved highly interesting. The constant movement of the white and red corpuscles up and down the blood stream is made plainly evident. Although corpuscles are only 1/25,000 of an inch in diameter, they may be clearly seen when the film is projected. Color pigment in the skin of the frog shows as plainly as flies on a window pane, and the steady pulsing of blood through arteries and its gentler return through the veins may be readily observed.

By administering various drugs, food elements, and such therapeutic measures as application of hot cloths or ice, the varying effects upon the circulation are faithfully recorded by the motion picture camera. It has been found possible to deter or accelerate the circulation almost at will. Even the heart can be stopped by interference with certain sets of nerves and started again by the simple expedient of exhilarating other nerves.

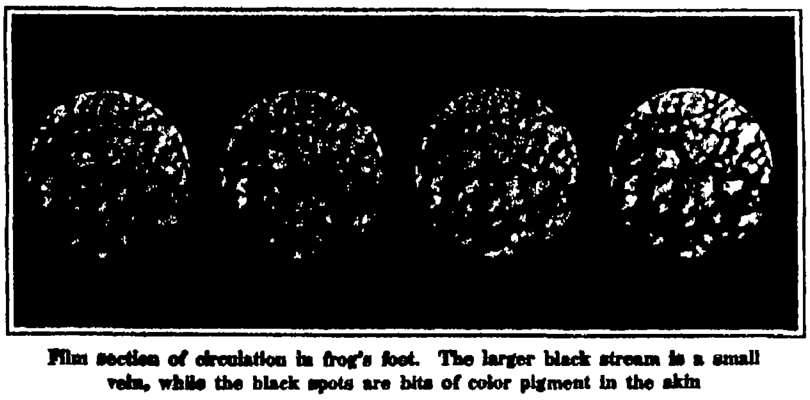
Two of the accompanying illustrations clearly depict the arrangement of the apparatus for taking the motion pictures.

General interest in the films showing the processes of blood circulation has been large. In the parlors of the sanitarium they are shown as an event of diversion for guests, and in this connection they excite as much interest as the most daring exploits of the film heroes from the celluloid "settlements" of Southern California or the film towns that border on the edge of the Palisades, across the Hudson River from New York City.

A Double-Negative Camera Which Reproduces Images in Natural Colors

ANOTHER valuable contribution has been made toward the development of color photography, this time in the form of a camera that exposes two negative plates simultaneously through the agency of a perforated mirror. Thus there are recorded on the two negatives the red color values and the blue-green color values, respectively, of the image photographed. Subsequently, as the various phases of the process are carried out, positive prints in the form of transparencies with images colored red and green, respectively, are cemented together, the two glasses removed, and the picture mounted on paper, canvas, ivory, or any other material that may be selected.

Filming section of an egg, showing the embryo chick. The film was intended to show the heart beat



Film section of circulation in frog's foot. The larger black stream is a small vein, while the black spots are bits of color pigment in the skin

The new camera and process of color photography are the result of years of research work and experimenting on the part of Percy D. Brewster of New York City. The point of distinct divergence between the Brewster process and other color photography processes lies in the method of exposing the two negative plates in the camera. Hence the camera will be considered first.

As will be noted in one of the accompanying views representing a sectional view of the camera, this consists of a light tight box arranged to hold two plates or negatives, *H*, *J* at right angles to each other. It is provided with a lens *A* and a shutter, *B*, of conventional pattern mounted on a movable front board for focusing as in the ordinary camera. *O* is the bulb tube controlling the shutter, while *D* is the bellows and *I* the focusing screw. Between the lens and the negative, *H*, in a direct line with both there is interposed a nickel or silver mirror, *F*, mounted at an angle as illustrated. This mirror is protected from oxidation, and its surface has been ground and polished to an optical flat by a well known telescope maker. Through the mirror there have been bored some 100 holes, each at an angle of 45 deg. in relation to the surface of the mirror, for this reason the mirror has come to be known colloquially as the "Swiss cheese" plate. It is essential that any light rays that pass through the holes in the mirror should not be interfered with by the metal backing, accordingly, the sides of the holes have been countersunk at an angle of about 40 deg.

It is an established fact that light radiates from every point in the object to be photographed into the camera lens, and is projected by the lens in the form of a cone upon the sensitive plate, the base being at the diaphragm point of the lens and the apex at the plate. If half of these light rays are cut off, the remainder will form just as perfect an image of the point photographed, although quite obviously, with only half of the light intensity, thereby necessitating doubling the exposure. This fact is taken advantage of in the design of the Brewster camera in breaking up each one of these cones of light into 20 or more parts, that is to say each cone is made to strike possibly 10 holes and so transmit to the back 10 beams of light *K* which recombine to form the image on the negative plate in line with the lens. Meanwhile, the portions of the cone of light which strike the solid parts of the mirror are reflected at right angles, *L*, and these too reunite to form a perfect image on the second plate *J*.

In the foregoing discus-

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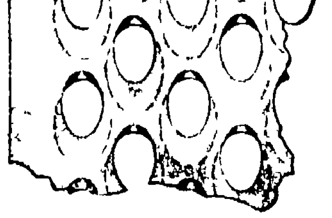
Color-photography camera which exposes two plates simultaneously, partly broken away to demonstrate its operation



The perforated mirror or "Swiss cheese" plate of the new color-photography camera

The Paper Situation

Factors That Are Responsible for the Present Stringency

By William Bond Wheelwright

AN extraordinary situation exists in the paper business. Prices of all grades are at the highest levels known since the establishment of commercial use of wood and wood celluloses as raw material. There is an actual famine in some grades of paper, and on practically all kinds the mills are weeks behind on deliveries, and some are even declining to quote on further orders.

Some idea of the production and distribution of paper in the United States is essential to a grasp of the situation. The following summary, taken from the *latest available Government Statistics of Manufactures* (1909), will give an adequate idea of conditions under normal times, although the quantity would have increased 66 per cent, assuming that the same average increase has continued in the years since 1909 that obtained during the preceding decade.

Of the 4 216 708 tons of paper of all kinds manufactured during the year 1909, 27 9 per cent was news paper, 19 7 per cent boards (i e box board), 18 1 per cent wrapping paper, 16 5 per cent book paper (including coated, plate and cover), 5 4 per cent building (roofing asbestos and sheathing), 4 7 per cent fine paper (writing, bond, ledger, etc), 2 3 per cent miscellaneous, 2 2 per cent hanging, 1 8 per cent tissue, 1 2 per cent card board, $^{7}/_{10}$ of 1 per cent blotting.

The distribution is made first direct from mill to user, second, from mill to jobber to user, third, from mill to broker to user—the last means is by far the least.

Under the first and third forms of distribution, the stocks, if carried at all, are stored mostly at the mills. According to the "New England Letter" for January, 1914, published by the First National Bank of Boston the normal stocks on hand of various classes were as follows:

News Print	11½	days supply
Boards	4	"
Wrapping	10	"
Coated Book	30	"
Book	14	" "
Fine Papers	48	" "
Tissue	11½	" "

In other words, the smallest stocks are carried in the grades which mostly pass direct from mills to large consumers, such as publishers and box makers, while the papers distributed by jobbers according to miscellaneous daily needs are more liberally stocked. Furthermore, the mills which manufacture standardized grades, colors, sizes and weights of paper, maintain considerable stocks on hand from which to fill promptly the jobbers' orders.

It is obvious, therefore, that a sudden and unusual demand may only be met by immediate increased production on the part of the mills.

Productive Capacity of Mills

The normal productive capacity of our paper and pulp mills was according to the 1909 census about 20 per cent in excess of their actual production and this condition undoubtedly prevailed up to the latter part of 1915.

According to an editorial in *Paper* (March 15th, 1916) the "Wrapping Division for the month of January, 1915, produced on an average 82 per cent of their rated capacity, while in January, 1916 the *same* mills produced 100 per cent of their rated capacity. In February their tonnage equaled 102 per cent capacity.

"The Writing Division in 1915 ran 82 per cent of their capacity which figure was considerably increased by the upward tendency in the last few months of the year. In January, 1916, they ran 101 per cent and in February the figures reached 105 per cent.

"The News mills reporting to the News Print Manufacturers' Association, showed a production a year ago of about 82 per cent capacity against 101½ per cent for February of the current year.

"Practically the same figures represent the Book Paper branch of the industry, which six months ago was running about 80 per cent capacity and for the month of February of this year shows a production of 101 per cent capacity.

"It may be asked how it is possible for any plant to run more than 100 per cent of its capacity. The answer is that the rating is based on the working days of the year, whereas recently some of the machines have been forced to operate on Sundays."

This remarkable and unprecedented response of our mills to the emergency means it is safe to say, an increase in the production of paper equivalent to 1,000,000 tons if maintained for one year, but its continuation presupposes a sufficient supply of raw material—this aspect of the case will be considered later.

Causes of Heavy Demand

What were the causes for so sudden and unheard-of demands upon the mills and what is the prospect for their continuance?

Newspaper Situation. At the outbreak of the war newspaper circulation increased, but as advertising fell off the extraordinary demand for print paper did not reach its height, until increased advertising, increased circulation and increased demands for export came into conjunction with one another, the result was an increase of 19½ per cent in production.

The situation was aggravated by a shortage in the usual stocks on hand—caused by labor troubles last May, which resulted, while it lasted, in a forced curtailment of several hundred tons a day. The statement of George F Steele, Secretary of the News Print Manufacturers' Association, published in *The Paper Trade Journal* of February 17th, 1916 states: "The manufacturers in addition to taking care of the decidedly increased domestic demand—have been extremely active in developing foreign trade. In fact, for the past year our manufacturers have been supplying practically all the trade of the English Colonies and South America. A good portion of this tonnage previously had been supplied from Scandinavian, German and English mills. Should war continue, there is every reason to believe that the necessities of the publishers in European countries will force them to come to us for a considerable portion of their supply—but I am pleased to say that the home manufacturers are practically all of one mind in this desire to supply home consumption first."

Book Paper Situation. In regard to the book papers the increase of production of 15 per cent in the last eight months is partly accounted for by the increased demands of magazines in which advertising has become so liberal—by a great revival of activity among book publishers and by the increased demands of direct by mail advertisers for their catalogues, folders, etc. On top of that is an unusual opportunity for export, which, however, has been somewhat held in check by lack of vessels, by the wish to serve home customers first, and by the precedence given to other commodities in the vessels available.

The Demand for Wrapping Paper. The demand for wrapping paper which was at a low point early in 1915 very naturally increased as business improved. The rising prices then started people up with a determination to cover for their future requirements until the mills were literally flooded with orders so that they began to decline business. This was especially true of the manufacturers of Kraft paper who depend very much upon a special foreign sulphate pulp which has not been so extensively made in this country as the sulphite pulp. Owing to the difficult manufacturing and shipping facilities the supply of this raw material has been seriously curtailed, and prices have increased heavily.

Other Papers. The unprecedented demand for all other classes of paper would entail a very similar recital and space prevents further particularizing, but it is important to state that the difficulties surrounding the manufacture of boards and of writing papers are acute because the importation of waste papers so much used in the former and rags used in the latter, of which nearly $8,000,000 worth were purchased abroad in 1913, soon begin to diminish. In 1915 the purchases fell to about $4,000,000 and now they are almost entirely cut off.

Conditions in the Jobbing Business

As has been pointed out in the case of papers which are constantly selling to large regular users only small surpluses of stocks are ever on hand—but what were the conditions in this respect with the stocks in paper jobbers' warehouses in the late summer of 1915?

Letters received from a number of widely scattered and important paper jobbers in reply to my questions about the paper situation, present a striking unanimity of opinion. During the late dull times, stocks had been allowed to run low, consequently the sudden resurrection of demand caught the jobbers more or less unprepared, because it mounted as unexpectedly as a tidal wave. It had been generally believed that the boom would ultimately arrive. The flurry of August, 1914, which accelerated the paper market for a few weeks, died away suddenly, only to be followed by the most depressed condition the trade had experienced for years, and business dragged so long that some were undoubtedly put off their guard.

Improvement in General Business

In the meantime money had been flowing into the country and the restoration of confidence on the part of business men came quickly to a head toward the end of the year. Increased costs of colors, clay, chemicals, coal, felts, wires, machinery and labor, not to mention serious freight embargoes, were gradually pressing the manufacturer harder and harder. The first necessity for a rise in prices sprang from the color situation about mid-summer, and it was about the only reason for advanced prices that buyers seemed to find convincing. Early in the autumn the next timid, though just advances were made by the mills. There was a marked tendency to hold back from time to time and see what the other fellow was going to do.

But necessity finally forced bolder advances on the mills, and instead of scaring buyers off it had the opposite effect, for at last all began to realize what might readily have been driven home by their own experiences—that costs were mounting imperatively and the little gradual business gains were not being followed by recessions. Consequently fear seized the buyers, lest they should be caught short of materials or only procure them at advanced figures.

The succeeding condition is well summed up by one of my correspondents as follows: "I think a portion of the recent shipments of paper has been for other than immediate consumption and that stock rooms of paper consumers have been filling up with stock for months ahead. Some paper jobbers are not heavily stocked, but it is because they have been sending out their orders from stock faster than the mills send them their new goods and when they receive the orders they now have on their books they will be heavily stocked."

Under ordinary conditions a reaction would be bound to result and in fact one is generally predicted by leading paper jobbers.

There are two factors which will have a bearing on the situation—the principal one being foreign demand.

Foreign Demand

According to Special Consular Reports No. 73, the total value of Germany's exportations of paper and paper manufactures in 1913 was $62,518,500. According to *Lockwood's Paper Trade Journal* for February 17th, Austria's exports approximate $10,000,000, Great Britain's $17,000,000—to quote more fully, "Germany and Austria, which have supplied to the outside world nearly $75,000,000 worth of paper, have suddenly been separated from their accustomed markets. Great Britain and France, which had normally exports of $40,000,000, are, of course, too busy to give much attention to their export trade, while the neutral countries accustomed to export quantities have been hampered by the difficulty of obtaining ships and the very high freight charges. Great Britain's exports of paper and paper products in 1915 amounted to less than $15,000,000 against about $18,000,000 in 1913, while in the case of France the falling off is much greater, the total paper exports being for the year only about one-half the normal."

It is apparent that a potential unsatisfied demand for paper and paper products, amounting to perhaps $100,000,000 a year, has been created.

Up to January, 1916, no striking gains in our exports of paper and manufactures of paper had been recorded. For the seven months preceding January, 1914, the sum amounted to $12,040,121—the same periods up to 1915 and 1916 showed $11,498,171 and $14,588,908, respectively. Nevertheless, the world's stocks must be extremely low, but shipments of the large export orders already booked have been retarded by the precedence given by manufacturers to their domestic business.

In this connection, the opinion of a leading exporter of paper is of interest. On April 5th, 1916, he writes me: "I believe the large business from abroad will continue so long as the European war lasts and home consumption does not require all of the product of the American mills, furthermore, that even after the European war ceases, the American mills will have greater calls for export than they ever had prior to August, 1914. I believe that a greater interest on the part of manufacturers of this country in export business, and a greater determination to have a fair percentage of their products going abroad, and going abroad whether home

conditions were favorable or otherwise, would create more stable conditions in the home market, and consequently greater benefits to the manufacturer.

"With the marked increase in prices, I believe the foreign demand in the future will not be greater than it has been during the last six months. On the other hand, if prices should ease off in this country, the export demand would exceed the demand of the last six months."

The other factor which may tend to check a severe reaction is the difficulty of immediately obtaining the necessary raw materials

Raw Material

The fear of shortage chiefly concerns chemical wood pulps—and especially the bleached. The average monthly importations from Europe for the last seven months of the years 1913, 1914 and 1915 were 21,911 tons, 30,694 tons* and 15,753 tons, respectively The decrease was partially offset by increases of average importations from Canada in the same years, as follows 1913, 5,606 tons, 1914, 8,828 tons, 1915, 13,211 tons.

It may be observed that the average monthly importation from Europe for the three years was 22,786 tons, and from Canada 7,654 tons, whereas the monthly average of European pulps imported in 1915 plus the increased monthly average of Canadian pulp, equals 20,136 The actual importation of European chemical pulp in January, 1916, was 12,985 tons, and from Canada 15,848 tons—total, 28 833 tons

Leaving out of consideration the question of what was bleached and what unbleached, no considerable foreign shortage is indicated, especially as the principal producers of wood pulps are not at war Further let me quote from a letter from a large importer of pulp, dated April 8th, 1916 "I do not anticipate any trouble in getting Scandinavian pulps—their asking prices just now are exorbitant—it seems to me that if the paper business should fall off somewhat here, and with the fact that there is a comparatively small shortage of unbleached sulphite, the market is apt to drop.

"The shortage is quite large in bleached sulphite, and still larger in Kraft pulp. I think that Sweden is trying to make the export of its pulp to England difficult on account of the embargo and export permissions issued at the discretion of the government. This would naturally give them more pulp for export to this country, all of which would tend to reduce the market"

A serious shortage in rags and waste papers was also encountered, as has already been pointed out Rags comprise 7 8 per cent of the fibers used in domestic paper making, and waste papers, books, magazines, etc, 21 4 per cent. About 123,000 tons of the former and 380,000 of the latter were imported in 1913 The rag situation was especially serious because rags are absolutely essential for making the better grades of writings, ledgers, blottings, cover and roofing paper Furthermore, they are used in the manufacture of gun cotton, and the munition makers have not hesitated to pay prices which are prohibitive for paper manufacturers Coupled with the indifference which our people had fallen into as to saving these useful wastes—the cessation of imports created a veritable panic in this market, which has only recently begun to find relief through more active domestic collections.

Remedies

This brings us to the consideration of what steps may be taken to alleviate the situation It would probably have been useless to hope to persuade people to desist from speculative buying after the market had assumed a "runaway" character, but it is decidedly to the point to encourage the saving of rags, books, magazines and other wastes fit for paper making Secretary Redfield, acting through the Post Office Department, has given material assistance in this direction, and three of my mill correspondents who are heavy users of rags write that already the situation is improving, and that they expect an approach to normal prices for rags by January 1st, 1917 It would also be desirable to increase our facilities for bleaching chemical wood pulps and making Kraft pulp.

Scientific forestry should be practiced in connection with our pulp industry Utilization of lumber wastes, which are now tremendous, should be developed further, and reforestration ought to be stimulated. In addition, new sources of raw materials, such as waste flax and other straws, sugar cane, etc., should be exploited The Government has for some years been carrying on valuable experiments in this direction through the Forest Products Laboratory and the Bureau of Plant Industry assisted by the Bureau of Chemistry The increasing costs and scarcity of timber point to a not very distant time when annual crop wastes will become commercially profitable for paper making.

In fine, everything possible should be done to make this country independent of others for its fibers, chemicals, clays, dyestuffs, and shipping.

* Note.—Unusually large quantities of foreign pulp were rushed to this country in 1914 in anticipation of future difficulties.

How May the Permanent Success of Our Dye Industries Be Secured?

By George H. Bruce, A.M.,LL.B.

THERE have appeared in the columns of the daily press and of this journal, and those of other scientific and technical magazines, many articles by able and learned writers, telling in detail the conditions in which the businesses using dyes, colors and intermediates were in at the beginning of European hostilities, how characteristically enterprising, able and venturesome business men proceeded, at the expenditure of much effort and money, to prepare to overcome this calamitous condition This with the only hope that they would receive the coöperation of the consumers and of the Federal Government.

Statistics have been given showing the marvelous development of these industries, and estimates have been ventured as to how many months or years might pass before these new businesses would be able to take care of the situation in a substantial way

Most of these writers, while gathering their data most carefully, very conservatively discounted the figures, with the result that they were invariably much below the real facts, but all of these writers have hesitated to speak with any degree of positiveness of the future Not that the progress had not been little short of miraculous, but that they were uncertain of two things of vital importance

First The possibility of securing adequate protection for these infant industries, secondly, the attitude of the consumers on this question of tariff and of the higher price for domestic goods And right here lies the crux of the whole matter The manufacturer will go just so far and no farther until the future is made reasonably safe

True, millions of dollars have been expended in the establishment of plants, and temporarily they are reaping their reward, but only after passing through the fire At the outset these industries, except in a few instances, were absolutely new in this country Machinery was not to be had readily, and when procured was invariably found inefficient, unreliable, faulty or expensively perishable The machine people were also going through the experimental stage The manufacturers had to contend with inferior raw material, frequently incompetent help, the chemical questions could only be settled by literature, always a most unsatisfactory way, because trained talent that could solve difficulties was not easily obtained, the little tricks and short cuts that experience brings were as yet unknown, and so, bravely and determined, they worked away while the plants experimented, and they saw their dollars go down the sewer in the shape of defective products

These same experiences were gone through generations ago in Europe, but never to the extent that they have been in America in the brief period of twenty months There appears to be no question that long established plants in Europe, having overcome the chemical and mechanical difficulties, discovered the most satisfactory machinery and economical units with low cost of labor, and abundance of cheap raw material, can produce and undersell the American manufacturers

This condition would continue unless the latter had adequate protection that would also be prohibitive to foreign imports for a period of four or five years, when, by processes of acquisition and elimination, he had discovered the best methods, the cheapest processes, the most desirable machinery, had well trained help and cast aside the crude, expensive, half experimental methods that must of necessity be pursued for some time in any new and untried industry

How, then, is this protection to be had? Never through the unaided efforts of the owners of the infant industries, but through the earnest, honest and persistent coöperation of the consumers Without this the effort is useless, and we must meet this situation face to face.

The future of the dye, color and intermediate industries in this country is in the hands of the consumers. If, blind to their own interest, they fail to see their future safety in sustaining these enterprises, then unquestionably these undertakings must die by the way side Some will, because of present abnormal prices perhaps make money for a time, and, having paid up the cost of their plants, write them off, and be able to exist for a time, but they must all end in the junk heap eventually unless the proper support is forth coming.

Is the ordinary consumer sincere in his protestations of allegiance to his brother, the manufacturer? Here and there is found a man who is willing to pay more for domestic goods and to continue to do so that the industry may prosper and become a permanency and save him from dependency on foreign manufacturers, but unfortunately this is not general Even some organizations, protesting their avowed purpose to secure commercial independence for the country by liberal tariff, are either grossly ignorant of the necessities or else insincere if judged from the so-called tariff bills which they are fathering

An analysis of proposed so-called protective tariff bills reveals to any one familiar with the manufacturing end that they offer no protection at all, because for all the reasons alluded to above the European manufacturers could still undersell the American and make a profit.

Would the American consumer then willingly pay more for American goods? A few, "Yes" the majority, "No" If you have the confidence of the average consumer, he will frankly tell you he feels he should buy where he can get satisfactory goods cheapest. That if he does not, he cannot compete with others in the business who buy cheaper, and that self-defense is the first law of nature He will go further and say that while he buys from the American manufacturer now in these necessitous times, that on the resumption of normal imports he would again buy foreign goods, giving as reasons that the foreign manufacturers could dictate, because, if by combination they would refuse to sell scarcer and finer goods unless the same market was open to the commoner ones that the purchaser would then be helpless, and at the mercy of the foreign manufacturer

Confessedly, it will be some years' work under the most favorable and promising conditions before American manufacturers will produce the finer colors and synthetics, hence the nurturing of those industries in the meantime becomes a serious problem

If the consumers could be made to see that not only their individual industries, but the very life of the country, depend upon the commercial success and supremacy of the United States, they might be willing to suffer temporary inconvenience to foster these businesses that promise prosperity and independence

We might well take a page from the book of experience of European industries, especially in the lines under consideration We find first absolute unity among manufacturers, specialization, with certain houses covering certain lines without conflicting or cutting by other houses, the Government coöperation, and the home consumer absolutely loyal to the producer The self sacrifice is willingly made where necessary the thought that the mother country or father land will be benefited being sufficient inducement and reward, a splendid commentary on the loyalty and patriotism of these people

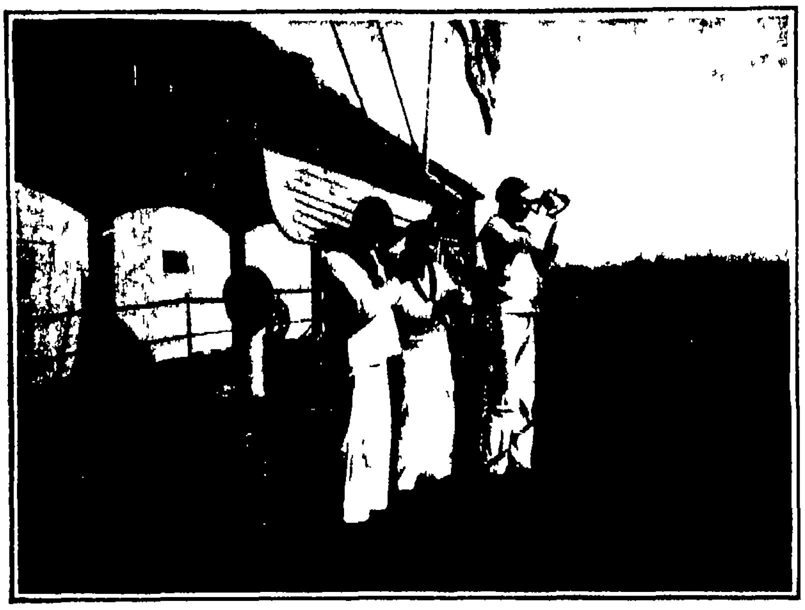
Here is the remedy for the condition and what would spell future prosperity for this country Adequate protection prepared by a permanent commission of men devoting their time, thought and research to this work only, and these men must be devoted to their work, free from political influences and bosses, free to act upon their knowledge and conscience, and they must be paid liberally enough to secure able men, who can thus afford to enlist themselves in the country's cause The appointment should be long enough to warrant men s devoting the best years of their lives without the fear that the changes of administration will send them out as derelicts after all other means of adequate livelihood are lost to them Neither partisan nor bipartisan boards should be considered as such The men should be selected first, and their particular political belief be a matter of their own concern as may be their religion

In securing able men who can and will devote themselves to so important a cause, the appointing power and the representatives of the people should be big enough to get the men, the right men, irrespective of their personal beliefs, nor is it desirous that such a commission be composed of experts, so-called, which ordinarily spells narrowness and non receptive minds. Rather let us have men with minds fresh, willing, able and receptive Students who with the departmental data available and the desire to get the best results for the people, will pursue all the ramifications of the subject With such men, and they are plenty, it matters not whether they are from the North, East, South or West, nor how they vote or what church they may attend, we will get honest work, with no axe-grinding

There never has been a tariff but has been evolved in the councils of one party as opposed to the other, with numerous pet constituents carefully covered, lacking both justice equality necessity and greatest general benefit and scientific construction and these conditions will always prevail until a permanent body devoted to the work takes it in hand

We must also have willingness on the part of the consumers to pay more for a time for domestic goods, and equal willingness on the part of the ultimate consumer to pay a slight advance to build up these industries because of the benefit it will bring this country by the permanent establishment of vast and necessary plants indirectly bringing to him his share of the general prosperity

(Concluded on page 480)



Learning to use the sextant

Bringing a ten-oared cutter aside

Our Nautical Schoolships

Conditions Show That We Are Far Behind Our Commercial Rivals Abroad

By F. S. McMurray, Supt. N. Y. State Nautical School

THERE are but two Nautical Schoolships in the United States devoted to educating and training Americans for responsible positions on shipboard. The gunboats "Ranger" and "Newport" have been loaned by the Navy Department to the States of Massachusetts and New York, respectively, for this purpose. These vessels are inadequate both in size and type for the best results in training purposes, and their annual output is limited to 100 cadets collectively, who enter our mercantile marine as petty officers or cadets, serving therein until they become of age or gain requisite experience for positions as officers or engineers of commercial vessels. Conditions have changed since the time when shipmasters received their initial training in the forecastle. The sailing ships of former days were in themselves excellent schools for developing traits necessary in men of the sea, such as courage, physical and mental activity and the knowledge of ship handling and navigation under a variety of conditions of difficulty and danger. It is no longer practicable or possible for American youths to enter our mercantile marine service under suitable conditions for advancement to command, unless preliminary training of an educational nature, applicable to sea life, is obtained in these schoolships. Because of the universal employment of foreigners in subordinate capacities on our modern commercial vessels, where the English language is seldom spoken in the forecastle, and the disappearance of the old time skilled seamen, forecastle experience does not produce suitable training for the advancement of Americans to high position on shipboard.

Conditions abroad are far different. The maritime countries of the world have long since recognized the need of special educational measures for training of officers and commanders of commercial ships, maintaining schools of a high standard for the purpose and developing the training ship method to a state of efficiency greatly superior to our activities in this line. Great Britain has 18 schoolships including some operated by public subscription. Others are operated solely by steamship companies for their own personnel. Germany has adopted similar measures. The German Schoolship Society of Bremen has been operating five training ships, two of which were assigned to the sole use of the North German Lloyd Steamship Company. They have lately issued a statement to the effect that their work is continuing unhampered despite war conditions, and they are prepared to furnish German mercantile shipping with trained officers and seamen to man vessels and extend the country's trade immediately upon cessation of hostilities. In the meantime 200 cadets and 20 officers from the training ships have been assigned to the Imperial Navy, where they have been placed on the U boats and destroyers, positions to which only the most efficient men are assigned. Japan takes a leading part in this educational work for the sea. The Nautical School at Tokio compares with our Naval Academy at Annapolis in efficiency and their training ship, "Tasei Maru," one of three, is a large four masted auxiliary ship with twin screws especially constructed for training purposes, which makes long ocean cruises about the world. Even Belgium, Brazil, Peru, Chili and the Argentine lead this country in nautical training, with the operation of suitably equipped training ships, that they may not be dependent upon foreigners for the manning and direction of their commercial ships.

The importance of this work is directly proportionate to the locality and magnitude of maritime activity. The State of New York, through which over half the foreign and domestic water borne commerce of this country passes and in which is owned and operated a majority of American shipping, is supporting but one training ship which is quite inadequate to meet present demands for its output and its accommodation. This school has lately been threatened with abolishment in the interest of economy in state expenditure, though its annual maintenance expense is but $80,000.

The New York Nautical Schoolship has been in existence for 42 years and has sent into sea service many of the ablest young Americans now serving our commercial interests afloat. Several of its graduates have become commissioned officers in the Navy and Revenue Marine, five are now at the Naval Academy. Several are in command of Naval Auxiliary ships, Government craft connected with the Lighthouse Service, Army transports and commercial vessels.

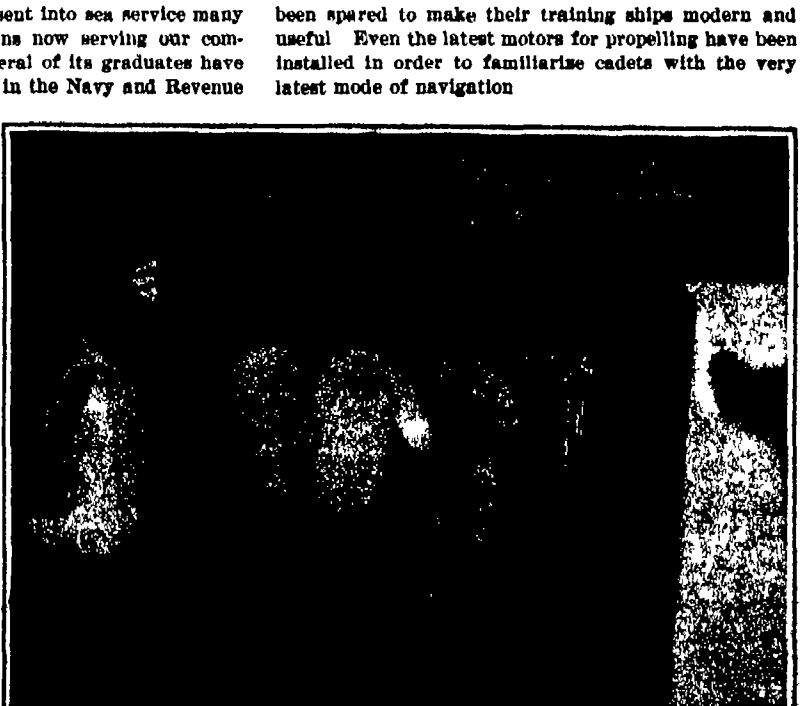
At the present time, with 230 ships under construction in American shipyards or contracted for, with a present demand for trained shipmasters and officers in American vessels so great that a suspension of our citizenship laws was considered necessary and ordered by our President, to permit aliens the command and officering of such admitted to-registry ships as have been acquired since the commencement of the European war, and with a shortage of officers in our domestic shipping which has caused great annoyance to local shipping companies through the levying of fines by our Federal Government, amounting to over $100,000, for failure to comply with the law which requires full complement of officers on shipboard, there is a crying need for additional support and extension of facilities in Nautical Schoolship training.

The negligence or apathy of our Federal Government toward shipping necessities, and especially this important feature among them, is incomprehensible, in the face of such legislation as the Hardy Act, passed in March, 1913, which required an additional or third officer on all American ships of over 1,000 tons.

An investigation of foreign methods in educating men for the extension of the trade and commerce of the world will show that we are far behind our commercial rivals in this respect, and do not seem to realize the necessity of sending able and educated men to sea in charge of our commercial shipping.

The report of the German Schoolship Society for 1915 states that it is regarded as one of the important institutions in Germany and that it has been one of the principal assets from which Germany has established its great merchant marine. Money and effort have not been spared to make their training ships modern and useful. Even the latest motors for propelling have been installed in order to familiarize cadets with the very latest mode of navigation.

Class in rope splicing



The apprentices at dinner

Instruction in the engine-room

Learning how to use machine tools

At this critical period of our national struggle to regain a foothold upon the sea, with legislation enacted favoring shipboard labor, something must surely be done to increase the efficiency and improve the status of the men in authority on American ships. The urgent need of these indispensable men and adequate facilities for their education and training, commensurate with the civilization and commercial growth of this great nation, indicate a grave economic loss

If our seaboard states cannot afford due support to this educational and vocational training for an industry of such importance to them, its continuance and enlargement should be undertaken by private means, endowment or public subscription as is done with other educational institutions or with some of the training ships abroad

The civic value alone of these training ships should warrant their support in the interests of good citizenship, through furnishing the many youths who desire a sea life with a disciplinary training on shipboard amid suitable moral influences and surroundings favoring their physical, mental and moral growth The experience which forms an undeveloped boy into a self reliant, thoroughly disciplined, capable citizen in a short period of intensive training, for civil or specialized military duty, is a valuable service to the community

How Gun Pressures Are Measured

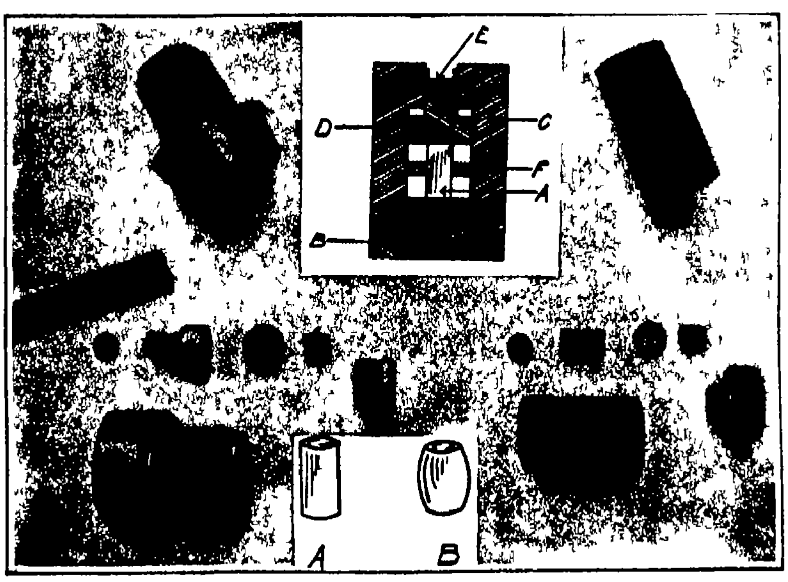
By Geo. P. Jewell

IF we desire a steam boiler to withstand a working pressure of 100 pounds to the square inch, we use material that should not give way until a pressure of at least 200 pounds is reached, we actually test the boiler with a pressure of perhaps 150 pounds which will probably develop any defects and yet not injure the boiler if the material is sound After the boiler is in service a gage is used to keep the fireman from letting the pressure exceed the 100 pounds for which it was designed.

An almost parallel case exists in gun construction. The pressure that will be required to drive out the projectile with the proper velocity can be computed and the parts of the gun can be so proportioned that they should not give way until perhaps twice this pressure has been reached. After the gun is made it must be tested with a pressure well above that intended to be used normally but not great enough to injure the parts if they are of sound material While the gun is in service a gage is not kept on it continually as with the boiler, but the same purpose is accomplished by testing each lot of powder to know that it will not give a greater pressure than intended.

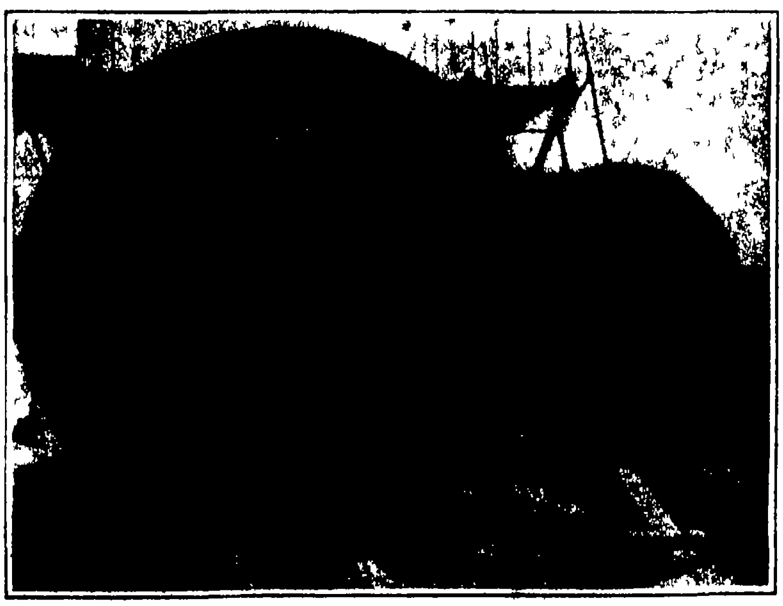
In both cases gages are necessary, but the instruments for measuring the relatively low and continuous steam pressure at low temperature obviously will not be suitable for recording the almost instantaneous pressure of hot powder gas at perhaps 40,000 pounds to the square inch. The gage used for the latter purpose is shown in cross-section in one of the accompanying sketches. The various parts going to make the gage are shown in one of the photographs

In the first drawing, representing a sectional view of the gage, the housing C is made of steel sufficiently strong to resist the pressure of the powder gas as it is placed inside of the gun close to the breech block or screwed into the latter when the pressure is to be measured The actual record of pressure is the amount that the copper cylinder A is compressed by the steel



Constructional details of the pressure gages used to measure the pressures attained in guns

The various components of the pressure gages are shown in the photographic portion of the illustration In the sectional view appearing in the upper center the parts indicated are A—Copper recording cylinder B—Closing cap C—Steel housing D—Piston E—Copper gas check F—Rubber or spring steel ring to hold copper in place. In the lower center drawing appears a copper recording cylinder before and after being subjected to the pressure from a gun discharge



Breech mechanism of a 14-inch gun, showing the mounting of two pressure gages on the face of the breech plug

piston D upon which the powder pressure acts directly E is a copper cup to prevent gas from entering the interior of the gage The area of the piston exposed to pressure is for convenience one tenth of a square inch This means that if the pressure in the gun is 30,000 pounds to the square inch the actual pressure on the copper will be 3,000 pounds In the lower drawing of the first illustration appears one of the copper pressure cylinders, which are of about the size of the rubber eraser on a lead pencil, before and after firing

The copper pressure cylinders are made from carefully selected metal to insure strict uniformity, and samples from each lot are subjected to varying pressures in a testing machine The amount the samples have been shortened by the different pressures is recorded so that a table can be prepared from which the pressure can be readily ascertained after the amount the copper has been shortened in the gun has been measured For example if the copper measured 500 inches before firing and 485 inches after firing, the difference would be 015 inches, and the table would show that the pressure was perhaps 15,000 pounds to the square inch.

In practice it has been found that better results are obtained if the coppers are compressed beforehand in a machine with about the pressure corresponding to that expected in the gun Accordingly, the coppers are supplied already compressed with pressure corresponding to those in the gun of 10,000 pounds, 14,000 pounds, etc A 14,000-pound copper would not be shortened by any pressure in the gun less than 14 000 pounds If a gun pressure of 33,000 pounds is anticipated a 30 000-pound copper is used, and so on Two gages are usually used to check each other and if the coppers are carefully placed in the gages the two will agree surprisingly well, generally within a few hundred pounds and frequently even more closely

Putting the American Paper Industry on a Scientific Basis

ACCORDING to a statement appearing in a recent issue of *Commerce Reports*, the attempt to place the paper industry of the United States upon a more scientific basis in its manufacturing processes received material support at the first annual meeting of the comparatively new Technical Association of the American Pulp and Paper Industry The paper expert of the United States Bureau of Standards was among the large number who attended the sessions and the Bureau's coöperation with the work of the association was tendered Methods of test and standard specifications for raw materials and finished products were discussed, interesting papers were read and plans were made to evolve from the organization a clearing house for technical problems arising in the paper industry

During the month of February last the Bureau of Standards made tests on 144 samples of paper for the United States Public Printer 115 for the various executive departments and independent establishments and 26 for persons and firms who had applied to the Government

There have been various other instances in which the services of the Bureau were extended in matters relating to the industry Assistance was given the Smithsonian Institution in obtaining samples of the highest grade papers The problem of increasing the opacity of book papers was taken up

War Game—VIII

The Effect of the Successful Double Envelopment

By Lieut. Guido von Horvath

THE enemy might choose to fight to the finish, which means the point where his power of resistance is exhausted In this case the enemy will be either driven from the battlefield or taken as prisoners of war

A wise commander unless he has orders to hold out till the last man will however, endeavor to release himself from the enemy's grip, and to withdraw before his forces are completely crushed

To make the last decisive encounter of the Blue and the Red forces on Lookout Hill graphically clear, we shall attempt to picture the actions from the layman's point of view To this end we shall place our war correspondent in the Observation tower on Lookout Hill and reproduce his report of what he has seen from 6 A.M on June 8th till the engagement passed beyond the range of his vision

"Lookout Hill 19— June 8, 6 A M

"Since four o'clock the first battalion has been in close touch with the enemy I had permission to accompany this battalion, and at 4 30 with the battalion reserves, we climbed the rather steep south western slope of Lookout Hill

"The enemy artillery sent a few shrapnel in our direction, but suddenly the fire ceased and almost simultaneously another battalion from the main body of our brigade extended our left flank

"From this moment on it was a rapid dash forward, till the crest of the hill was reached Once there a mean flanking artillery fire hit us from the forest edge It was a staggering blow and for a while we lay panting, helpless, many men were wounded in the line with me, and one shrapnel after another burst with terrible accuracy over us It seemed a year before something else happened another dash forward, and I climbed on all fours toward the Lookout tower, which was but a few hundred yards to the right During these moments of intense fire action, something must have happened to the enemy's battery, for its shells ceased to come toward us.

"I later learned the reason

"Encouraged by the seeming lull, I decided to climb the Tower It is a well built steel frame tower and I shall never forget the impressive picture I beheld from its top.

"The Blue forces, like waves, rolled forward to the right and to the left The Red artillery lost two guns, the very two which had been shelling our enveloping battalions, but four more guns were busy shelling the right wing of Colonel K's forces

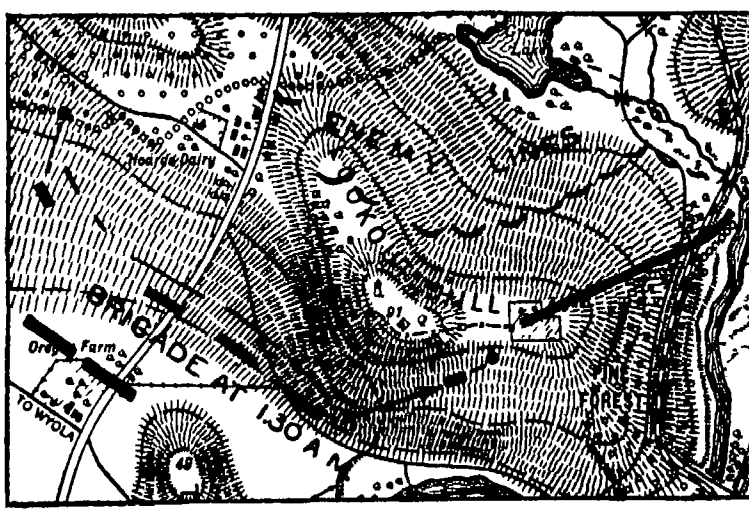
"Over the bridge, slightly to the east of the lake, went straggling Red cavalrymen, losing heavily, but finally gathering behind the lone house near the lake, from which position they retired toward the forest edge

"Other troops were hard pressed by our forces and lost many in wounded and dead whose inert bodies dotted the green flower bespangled hillside and meadow around Green Lake

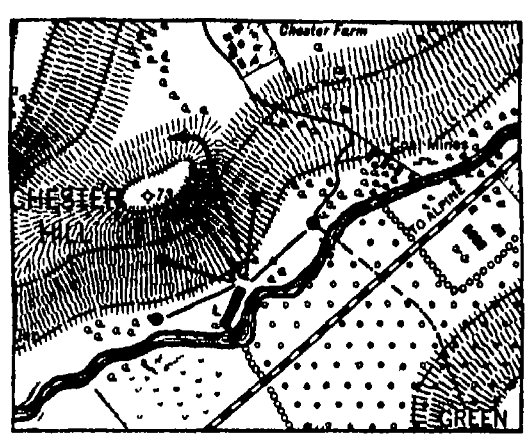
"In less than 40 minutes there was not a Red soldier in sight except these staggering struggling or dying men on the ground Yet though the Reds were not visible they were far from inactive, nor did it seem that they were ready to give up A deadly fire was pouring from their splendid defensive line along the forest edge

"I wondered how all this would end It seemed to me that the Reds must expect reinforcements, or they would have hastily retreated in order to avoid the stifling, enveloping forces which were drilling into their right wing troops with a steadily increasing impetus.

"With me in the Tower was an artillery officer, with a telephone instrument hanging from his neck. He noted my badge and paid no more attention to me From time to time he spoke into his instrument which



Answer to question 1 of War Game VII



Answer to question 2 of War Game VII

The attack, with double envelopment

Sketch of the Positions and Lines of Advance, as seen from Observation Tower on Lookout Hill

action brought a hush and thunder from behind Argus Farm, soon a little cloud appeared near the forest edge, just to vanish again.

"The enemy batteries were well masked behind the trees and I could see how our guns were, so to say, searching point after point, in an effort to locate these batteries. We, also, lost a gun, the shattered wheel of the upturned cannon lay in a heap with four artillerymen. One caisson was hit point-blank by a shell and there was an explosion. While my eyes swept from place to place over this everchanging field of action, I suddenly saw heavy reserves push by the Tower and I realized that our solitude here was to be invaded.

"Brigadier General L. G, with his staff, had arrived. The General glanced around with deep concern, he searched the northeast with bare eyes, then hastily unslung his field glasses. I wondered. The anxiety on his calm face presaged grave events to me We knew there were strong enemy forces in the north. At an impulse I followed his direction with my own powerful marine glass.

"'There! There, now!' I heard the aide exclaim.

"The right wing of our forces pushed forward, nearing the lake Farther north, on the forest edge, there appeared to be some motion among the Red forces.

"Again I heard the aide speak. 'It is all right. In ten minutes we shall see!' He laughed and lit a cigarette.

"The General remained in silent watchfulness. Suddenly I grasped my glass and directed it toward Chester Hill. There, behind the railroad and the Bixler buildings, like a line of blue ants, a skirmish line of Blue forces started forward.

"At exactly 6 15 A.M the first bullets snapped into the left wing of the Reds.

"What a change it made, this sudden attack from an unexpected quarter!

"As I searched the firing line of the Reds, I saw that something was happening there Suddenly there were only two enemy guns in action. No the other two were not hors de combat, they were dashing at a gallop, back up the Greenville road Moreover, troop after troop of Red cavalry were evacuating the forest edge That gigantic machine stretching over miles began to draw together Our left wing dashed forward, the center followed, a rapid fire was delivered by the right flank and the artillery

"While the left pushed on, the right, up Timcum Creek, also moved on and all of a sudden the firing practically ceased. Our soldiers dashed forward, and were swallowed by the green forest.

"Far behind the northern edge of the forest the two guns which had escaped were unlimbered and their shells began to burst over their former defensive line. A few minutes later one of our shells silenced one, then the other, while two squadrons of Red cavalry retreated toward Greenville.

"At 7.30 A.M. the battle of Lookout Hill was won by the Blue forces. The larger portion of the regiment of Red cavalry successfully retired, but the infantry of Lieutenant Colonel LC suffered heavy losses in dead, wounded and prisoners."

* * * * *

The accompanying sketch shows the situation at 6 15 A.M., when the envelopment of the enemy's left flank was first felt by the enemy

The Duties of the Victor

In the foregoing, we have shown the successful assault of superior forces, which brought a decision through a double envelopment.

The enemy has been beaten, and has attempted to avoid complete annihilation by a hasty retreat. Now the success which has been gained by the Blues must

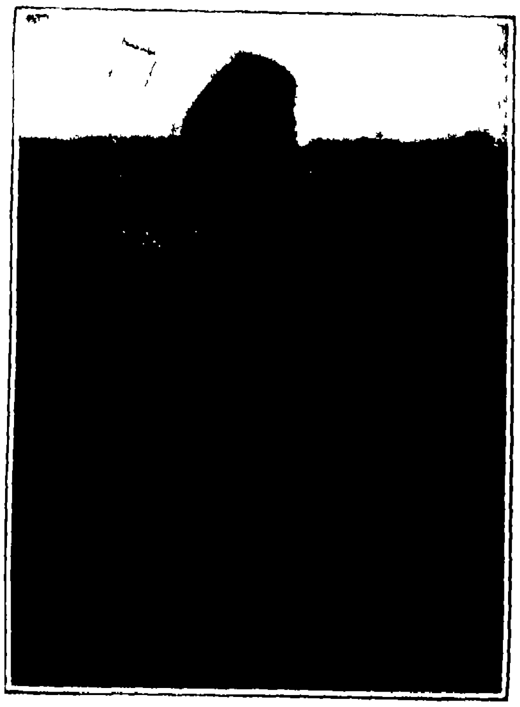
(Concluded on page 486)

Assembling a heavy artillery wheel with a hydraulic apparatus

A British naval gun hidden somewhere in the Balkans

Gas apparatus captured from the Austrians in the Alps

Sheet steel plates for trench covers



Folding periscope for trench use

A coffee percolator on wheels for the Belgian army

Shower-bath truck presented to the French by Russia

Periscopic attachment for rifles

Running to man the anti-aircraft guns

SOME NOVEL INVENTIONS OF THE PRESENT WAR

Cartridge Cases of Steel

Has Germany Found a Substitute for Drawn Brass?

By Edward C Crossman

WITHIN the memory of quite a few thousand somewhat aged but sprightly gentlemen the Northern and Southern States of the almost United States argued out a little political difference with rifles using paper cartridge cases To be technical these were not cartridges at all, but merely paper packets to join bullet and correct powder charge in one The soldier bit off the end of the paper poured down the powder from the muzzle end of the rifle then rammed home paper and bullet At times when excitement pressed he for got to pull the trigger or to cap the gun, and accumulated three or four loads then, when he finally did perform the correct operation all the way through, the results were astonishing if not pleasing

Ten years later when the French and Germans flared into what in comparison with the present war was little more than a skirmish ballisticians and rifle designers had carried the paper case to its highest development after which it was promptly dropped Prussian shot inaccurately if spitefully at Frenchman, with the Zund nagel, the needle gun, a strange and wondrous weapon, a breech loader using a paper cartridge which in turn contained 74 grains of dirty black powder and a generous man stopping slug of lead weighing 478 grains A steel cylinder, the bolt of the modern rifle of which the needle gun was forefather, was unlocked by turning it through a quarter circle by means of the bolt lever or handle The paper case was slipped into the chamber of the barrel, and the bolt closed behind it. In the base of the bullet was placed a little fulminate of mercury, sensitive to blows, the primer of the cartridge Inasmuch as the powder charge lay between the bolt and the bullet, the needle of the gun to fire the cartridge, had to stab through the powder before reaching the primer, and the effect was truly beautiful

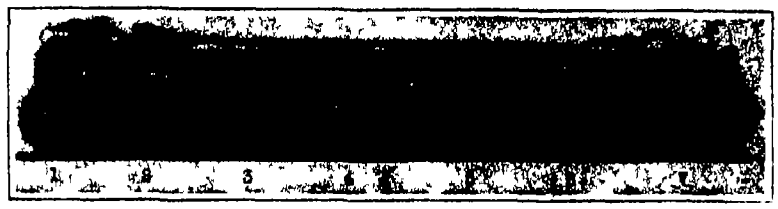
When the trigger was pulled a needle impelled by a spiral spring in the bolt stabbed viciously through the paper base of the cartridge, through powder, and into the fulminate on the bullet Whereupon the 74 grains took fire, and a 16-gage slug departed from that rifle on its wobbling career, while fireworks of sorts spouted from the breech of the rifle until after a couple of such seances the canny Hans took to firing the gun from the hip

Said fireworks were the result of in sufficient sealing of the breech by the bolt head and the paper of the cartridge—insufficient obturation as the artilleryman has it The gun would fire all of 500 yards, but at 200 yards was not always certain of hitting the landscape once in three shots Sometimes the needle, right in the midst of the fire which it produced, would burn or break off a natural result of steel exposed to the constant heat of burning powder around it.

On the other side of the small space separating the two sets of gentlemen, Jean was better provided with the chassepot, another bolt rifle of crude design and paper cartridge, but more sensibly having the primer at the base of the cartridge not at the base of the bullet. The bolt carried an India rubber washer to help keep the gas from the face of the soldier

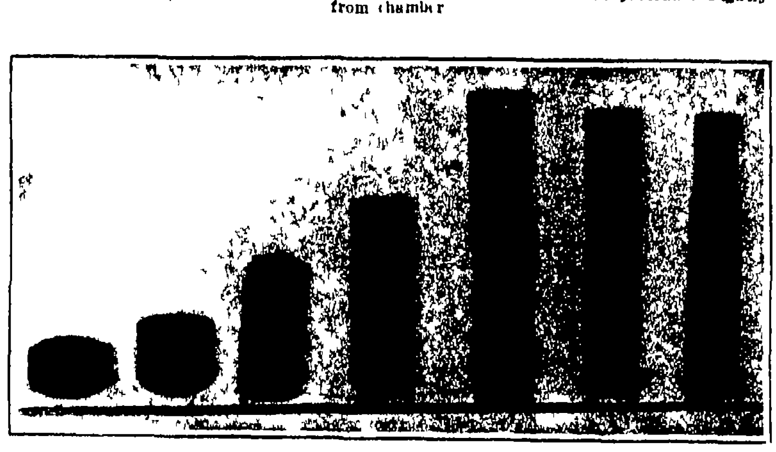
At that stage of the world's progress ballisticians knew better than to use paper cartridges but both French and Prussians were the victims of the usual slowness of army boards to take up improvements, particularly when the boards are made up of Colonel Fussy and General Mossback, both of whom had seen service with the old weapons and did not believe better could be had The problem that confronted the ballisticians and designers of those days was to find some way to seal the breech of the breech loading rifle Paper skin linen rubber, all failed but finally the inventor of the pinfire cartridge hit on a combination of a solid paper case with a base of brass, the progenitor of the modern shotgun case To this day in the huge four and eight bore black powder British express rifles the paper and brass case the modern shot gun case, still is used

But in the military rifle this did not prove a happy combination, and the paper case was tried and abandoned by the British in the old Snider in the '60's in favor of a case made of coiled sheet brass, rolled very thin It was crude, but it served the purpose of sealing the breech of the rifle Although Mauser developed the solid drawn cartridge case of brass or copper before the end of the Franco-German war in the seventies, the British clung to their faulty and crude coiled brass case until it was finally discredited by the Egyptian campaign of 1888



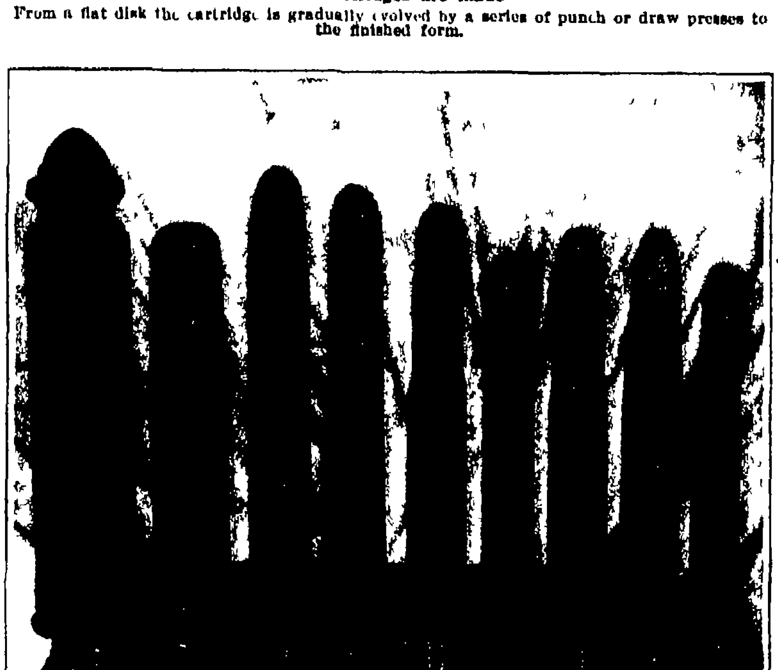
Some examples of the weakness of the brass cartridge case

1 American service case before firing 2 American service case fired with chamber pressures higher than 60 000 lbs per square inch case has flowed sideways primer pocket greatly enlarged case ready to burst 3 Ross 280 case with primer pocket enlarged 4 5 6 same cases that have burst under high pressures 7 old type rim case which properly supported, stands more than the modern rimless case which protrudes slightly from chamber



How cartridges are made

From a flat disk the cartridge is gradually evolved by a series of punch or draw presses to the finished form.



Some examples of modern solid drawn brass cartridges

The coming of the solid drawn brass cartridge case marked the real development of the breech loading rifle, and it has been the standard from 1870 to the present great war, in which the Austrians alone have fired one and a half billion rounds of ammunition so prepared.

The modern cartridge case must serve to hold powder bullet and primer and it must seal the breech of the rifle against a gas pressure of as high as 60,000 pounds per square inch of chamber area. Not only must it do this but it must be of such temper as to spring back from the chamber walls after being driven into every minute crevice by this terrific pressure, and practically free itself before the strain of the primary extraction is put on it by the extractor of the bolt of the rifle or machine gun This temper must not be too high because then the neck of the case will split, make that case useless for future reloading, possibly stick in the rifle, or possibly break off, disabling the gun. It must be of such uniformity in dimensions both in its loaded and unloaded state as to function surely through the mechanism and the chamber of the machine gun firing 600 rounds per minute Too much "tolerance" between case and chamber walls results in split if not broken cases and disabled gun Too much or little length—headspace—will result either in misfires in the machine gun or else in failure to close, and a balk All of these things are measured in thousandths of an inch.

The anxious effort of the British to shut off copper from Germany, and the diplomatic correspondence regarding it, and the hope of the British that copper shortage will prove one of the deciding factors of the war are all because of the importance of the little brass cartridge case.

The modern case is made of a mixture of copper and zinc—spelter—to give the right temper and tenacity under the high modern pressures. The first stage of manufacture is the stamping out of little brass disks from sheet brass—little 25-cent pieces done in yellow metal Then the disk starts through its gauntlet of draw presses and annealing ovens. A draw press is merely a solid machine containing a die and a punch The die gives the little disk its first shape under the pressure of the punch, this a shallow little brass cup Then a series of the presses gradually draws out the cup to the shape and thickness of the finished case, without the head As drawing tempers and makes the brass brittle, frequent annealing in special furnaces is necessary, and after each annealing, cleaning and washing of the cups The final operations trim the case, form the head upon it, form the primer socket, pierce through the fire or flash passage, and then reduce or neck down the shell to the proper bullet caliber It is necessary finally to anneal the mouths of the shells after this necking down.

That almost perfection has been attained in all these many automatic machinery operations, let the fact of the successful use of machine guns testify The machine gun is utterly at the mercy of its ammunition The cases made in the United States Army Arsenal at Frankford, Pa, will stand reloading 25 times without giving way

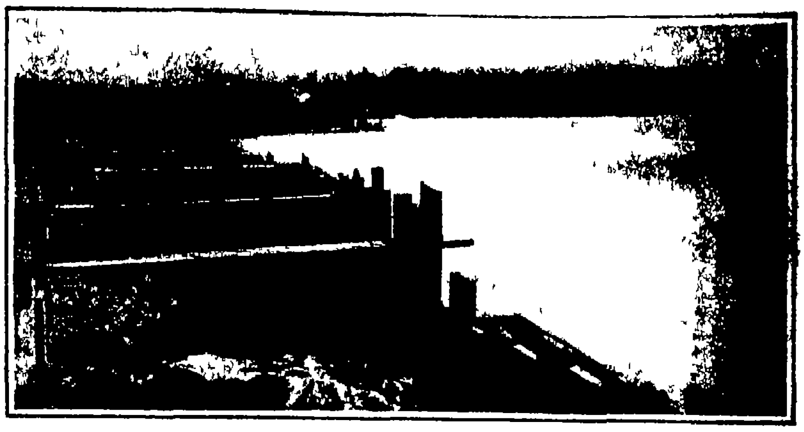
To guard against the danger of shells that have been annealed by being swept up in some bonfire on a rifle range and that would stick in the rifle or machine gun because of their soft condition, all empty cases before being reloaded are put through a sort of reversed scleroscope at the arsenal, this is an inclined steel plate upon which the fired cases are dropped from a little elevation The normal cases, still possessed of the right temper, bounce over a little fence from the steel plate, the annealed cases, being soft, fail to clear the boundary and are thrown out.

But while brass cases are mechanically perfect, they have reached about the end of the strength of brass, and rifle pressures are going up and up. Between the army rifle and the velocity of 4,000 feet per second, with the resulting danger space of about 1,000 yards over which the sights of the rifle need not be changed, there stand these obstacles. Erosion of barrel steel through very high chamber pressure; metal fouling, caused by the friction of the cupro-nickel jackets on the steel of the barrel; flowing of the brass case under the high powder pressure.

Improvements in powder by American makers and future improvements in steel will take care of the first; alteration of the jacket composition of the bullet or some system of lubricant applied by means of the powder, will obviate the second; but the third can be taken care of only by the substitution of a different metal from brass.

(Concluded on page 490)

Dry dock excavating. Engineers at work in the river bed of the Mississippi protected by cofferdams



View of pumping fleet in operation at lower end of cofferdam, showing wing of cofferdam extending shoreward

Blasting a Canal Through a River Bottom

Cutting Through the Rock Bed of the St. Claire Rapids

By O. R. Geyer

FOUR or five years from the present time the last great terror of the Mississippi River will have gone the way of the famous Hell Gate rocks and other equally noted obstructions to navigation, the trials and tribulations of the pioneer river boat captains and pilots will then be but a memory. Some months ago United States engineers began blasting a canal 250 feet wide, 3 miles long and 6 feet deep through the solid rock bed of the St. Claire rapids, the most treacherous spot along the 2,000 miles of waterway to-day. This is the greatest project of its kind ever undertaken by the Government, which is paying $1,300,000 for the novelty of digging a canal through a river.

The canalization of the Le Claire rapids will be one of the greatest single improvements ever made along the river and will remove the last great barrier to a six foot channel. It will make the art of navigation on the Mississippi as safe as steering one's course down the main street of his home town. Boats of heavy draft will be able to pass the rapids at any time during the day or night, even during low water stages, instead of being subject to Government orders which forbid the passage of the rapids in the night time as at present. Since the first steamboat chugged its way up the river about 70 years ago, river craft have been moored just above or below the rapids at the approach of night time.

The jagged rocks have slashed the bottoms from many a boat, as well as wrecking countless rafts which attempted to pass this dangerous stretch of water. Millions of feet of lumber have been slashed into ribbons while being "rafted" over the rapids, and the Government's timely work is expected to give considerable impetus to the movement for the revival of inland navigation.

The work was gotten under way last fall and the work of blasting the rock bed has been carried on without intermission since that time. The Iowa shore is utilized as one bank of the canal while the other bank is formed by a cofferdam nearly three miles in length which connects with a closing dam at the lower end of the canal. The lock which will be used in raising the stage of the river through the canal will be one of the biggest engineering works ever attempted on the river. The closing dam at the lower end will be 400 feet in length, 78 feet wide at the base, 12 feet wide at the top and 22 feet high. The lock will be 80 feet wide and 350 feet long.

The Government engineers began their task with the most complete equipment the construction camp on the Iowa shore below the town of Le Claire being built on a lasting scale. An immense electric centrifugal pump, two steamboats, two dredge boats, a steel drill boat, three unloading derricks, building boats, seven ton steam shovel, three locomotives, locomotive crane, numerous dump cars, three portable air compressors and seven jackhammer drills comprise the major equipment. Since last fall 5 miles of railroad track have been laid in the river bed and along the top of the long cofferdam.

The big pump has emptied the water from a tract of about 85 acres on the river bottom, and dry rock excavation has been carried on all winter. The first section of the cofferdam was 8,680 feet in length and has been closed in at the lower end. When this section of the river bed was exposed to the air for the first time, clammers reaped a veritable harvest as the river bed was lined with clams.

Before the cofferdam is completed 2,000,000 feet of heavy timbers will be used in construction work. Heavy yellow pine planks are used in making sectional cribs which are sunk on the line of the river wall of the canal. This work has required all the skill at the command of the large force of engineers and workers, owing to the fact that the water is about 26 feet deep and the current so swift that none but the best work can withstand its terrific force. Steamboats pushed barges loaded with gravel and sand alongside the cribs and dumped their loads with the aid of the unloading barges. Heavy rock was dumped alongside the dam to provide protection from the ice and swift current, but despite these efforts ice jams and high water have caused several breaks in the cofferdam. One of the latest was on January 23rd, when a break occurred about midway in the dam, allowing the pit to be flooded. About three weeks' time was required to repair this damage.

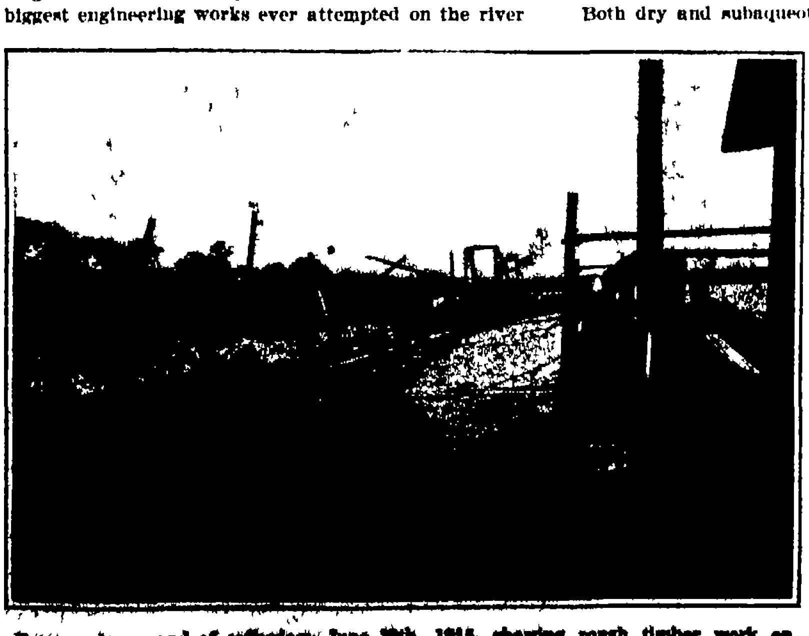
Both dry and subaqueous excavating work was carried on during the early part of the winter, but after cold weather set in this work was limited to dry rock excavation. This feature of the work will require a year's time, as it represents about half of the canal area. About 300,000 cubic yards of rock and gravel, mostly the former, will be excavated by the United States engineers. Of this amount 107,000 cubic yards of rock will be removed by dry excavation. An important aid in the underwater work is the special drill boat which can bore three rows of holes with 28 holes in each row at one time. Blasts of 400 pounds of dynamite shoot columns of water 50 and 75 feet into the air and attract hundreds of visitors along the Iowa shore.

At the lower end of the canal is Smith's island, which forms part of the outer wall of the canal. Levee walls nearly a mile in length will be built on the island to protect it from the high water which will be backed up by the dam at the lower end of the canal. This work will not be begun until steam shovel excavation is completed in 1917. Work then will be begun on the lower end of the cofferdam and the closing dam and lock.

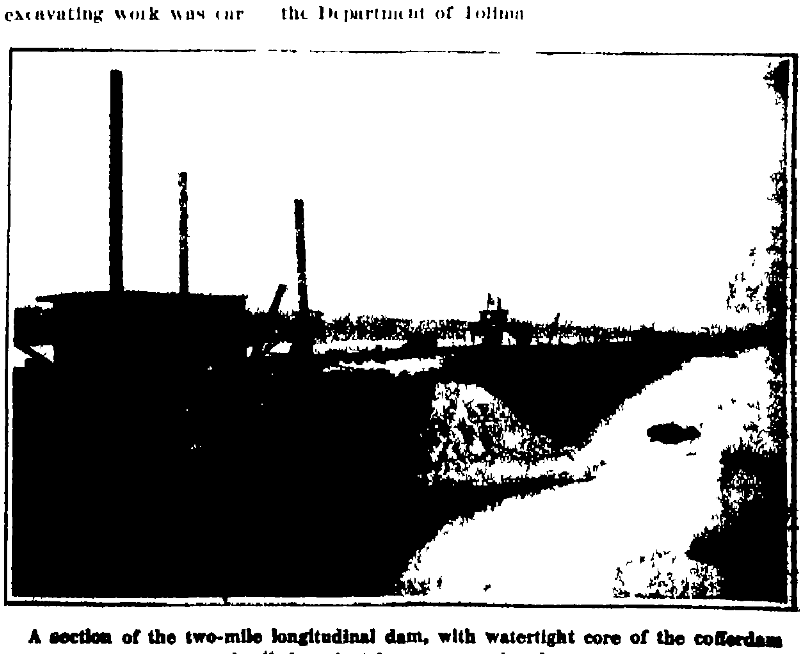
The work is in charge of H. E. Reeves, assistant engineer. The Government camp and storage yards are located near the head of the canal. The best of accommodations are given the men who will make this their home for several years to come. It is expected that the canal will be ready for use by 1921, its completion being delayed somewhat by the fact that only a small portion of the appropriation is available each year.

The Platinum Industry of Colombia

ACCORDING to the report of the United States Consular Service at Cartagena platinum is found in Colombia near the headwaters of the Atrato and San Juan Rivers in the Intendencia del Choco. Nearly all the streams of this region yield the metal but the gravels of the Condoto River, it is said, pan out more richly than do the others. Platinum is also found although in smaller quantities in the fluvial sands of the Department of Tolima.



Extreme lower end of cofferdam, June 30th, 1915, showing rough timber work on floating pontoon fastened to anchored spud boats



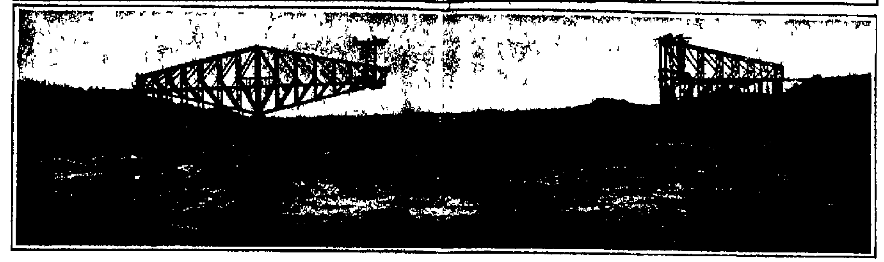
A section of the two-mile longitudinal dam, with watertight core of the cofferdam rock piled against it to prevent ice damage

The New Quebec Bridge

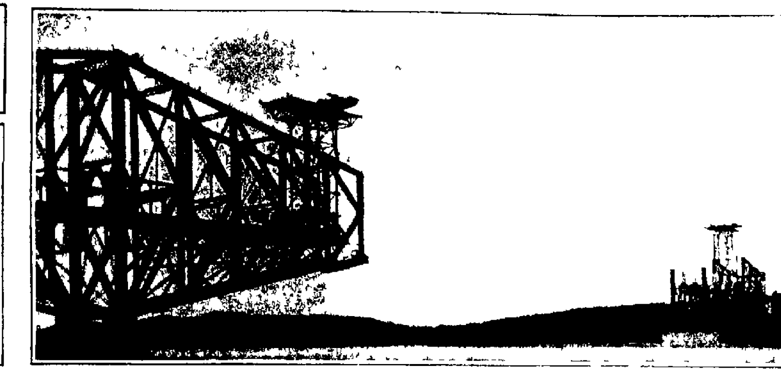
Progress of Erection of the World's Longest Cantilever Span

By A. J. Meyers

The traveler on its last trip to the main pier, placing the upper member of the north anchor arm, November, 1914



Status of the bridge last November when work was halted for the winter season. Work is now proceeding on the south cantilever and the structure should be ready to receive the center span next September



The north cantilever arm and the south anchor arm in the process of erection Note the "flying bridge" supporting the last placed section of the bottom chord

Placing one half of the main link, connecting the cantilever and anchor arm top chords, at the top of the main post, 350 feet above the water level

ON the 12th of November, 1915 when the last member of the north cantilever arm was put in place the third season's work in connection with the erection of the superstructure of the new Quebec Bridge was brought to a satisfactory close

The season of 1915 was remarkable on account of the great amount of tonnage handled the rapidity of erection, and the clock like regularity of the advancement of the work Except at times, from the inclemency of the weather and high wind, there was practically no unforeseen delay of any consequence, and the work progressed according to schedule in a manner that attested to the careful and well thought out plans

During this, the third season's work the tonnage erected, amounting approximately to 30,000 tons, was over twice as much as that put in place during the seasons of 1913 and 1914 combined

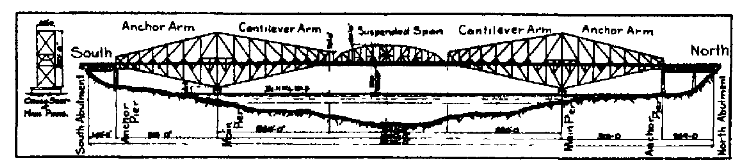
During the summer of 1913 the approach spans on the north shore from the abutments to the anchor pier were fully erected by means of a derrick car These spans were erected partly on wooden and steel falsework and the longer spans partly cantilever The last supports for the longer approach spans were at the first panel point past the center on the side nearest the anchor pier Here they rested on sandjacks on top of the steel bents When the spans were completely erected they were lowered onto their shoes on the anchor pier by means of these sandjacks

During the fall of 1913 and the following winter the 1 000-ton traveler standing over 200 ft high, carrying two electric travelling cranes capable of lifting 110 tons each, and four 70-ft 30 ton derrick booms, was erected just back of the north abutment This traveler was completely finished by May 1914 and one week later it was moved over the approach spans to its first position over the anchor pier The approach spans had previously been equipped with special brackets carrying a special line of outside stringers for supporting the traveler track, and also at several points had been reinforced to carry this excessively heavy concentration

From its position over the anchor pier the traveler, on May 21, 1914 began its work of erecting the falsework and superstructure of the north anchor and cantilever arms, which it finished as stated above, on November 12, 1915 consuming in actual working time some fourteen months, during which time it erected, including falsework and bridge material, approximately 35 000 tons of steel

The traveler on the first trip out to the main pier erected the inside staging which carried the main bridge floor material and extra lines of girders for the traveler track, and also erected the outside staging which supported the main trusses sway and lateral bracing of the anchor arm

This work was completed early in July, and on the 18th of that month the erection of the main shoes on the north main pier was begun. Each of these shoes weighed about 450 tons, and was shipped in sections weighing up to 50 tons The lower story is made up of four steel castings, each casting weighing about 40 tons The middle and top stories are made up of four webs running 9 inches thick in places, spaced to correspond to the webs of the bottom chords, compression diagonals and main post These webs are reinforced and supported by heavy cross diaphragms, spaced about two feet centers Extreme care was taken to insure a perfect bearing on the bridge seats for these shoes, and in placing them exceptional precautions were taken to see that they were properly alined



Diagrammatic view of the bridge Note the suspended center span

The shoes being erected, the bottom chord, some pieces of which weighed over 100 tons, with its lateral bracing was next laid from the main pier to the anchor pier

The traveler was then brought back to the main pier and commenced the placing of the web members below the middle or "K" joints This work was finished by November 18th, and the traveler started on its last trip to the main pier, completing the erection of the upper portions of the trusses and sway bracing except the last two panels next the main pier

The work on the north anchor arm for the season was then brought to a close—December 3, 1914

The work on the south shore during the season of 1914 consisted of the erection of the south approach span, the mode of erection being similar to that followed for the north shore approach spans, as described above. Also about two thirds of the south shore traveler were erected before the close of the season

In connection with the erection of the anchor arms, after the bottom chord had been completely riveted up in a straight line, it was jacked down to a curve sufficient to bring the top chord panel points about one inch closer together than the normal shop lengths of the eyebars demanded This was accomplished by slotting the pinholes in the eyebars ½ inch in the direction opposite to the bearing surface The pinholes at the upper ends of the main tension diagonals were slotted 2 inches in a similar manner The purpose of this camber was to avoid as far as possible any difficulty that might arise in driving the huge pins used for connecting the main members

Work on the north shore was resumed in the spring of 1915—about the middle of April The erection of the anchor arm was completed and on May 3rd the placing of the main posts was begun Each post, standing 310 ft high weighing approximately 1 000 tons was shipped in 27 pieces The two were assembled simultaneously and the work of erection was completed by May 31st The outside dimensions of these main posts are about 10 ft by 10 ft and although there were six full horizontal field splices in each post, the final distance center to center of end pins was as nearly accurate and the bearing surfaces of the pins as nearly horizontal as it was possible to measure

In the erection of the cantilever arm which was begun on June 9th the panels are completed as the traveler advances, the final bracing for each panel being put in by the rear booms of the traveler On account of the large section and the length the bottom chords are fully spliced twice between the main panel points This necessitated that they be supported while the different parts were being assembled and lined up on what is known as a "flying bridge This flying bridge" is attached at the shore end by a pin driven through a temporary bracket which is bolted to the bottom flange of the chords already placed and the front end is tied back to the compression diagonals by means of yoking girders and links The adjusting of the chord for riveting and driving of pins connecting the chords to the tension verticals was made by means of jacks placed on this bridge As each panel was completed the bridge was taken up by the cranes of the traveler and moved ahead to its new position

The operating schedule for each panel of the cantilever arm was approximately as follows

With the traveler standing with its front legs at a main panel point, the "flying bridge" was moved forward into position, the first panel section of the lower chord placed with its portion of the bottom lateral

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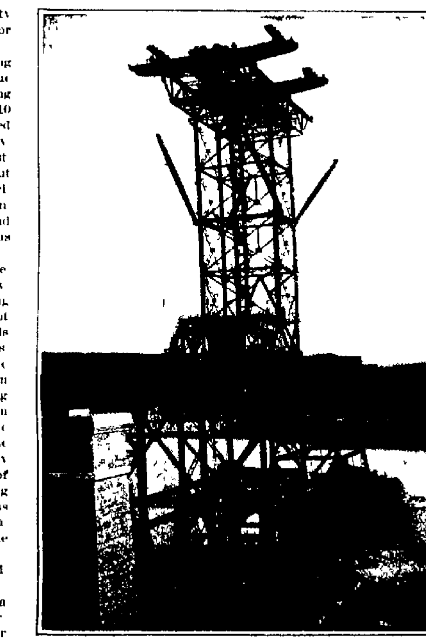


The traveler, having finished the placing of the shoes on the main pier, is laying the bottom chords of the anchor arm on the outside staging

The north anchor and cantilever arms, completed November, 1915

Showing the enormous size of the details at the middle or "K" joints

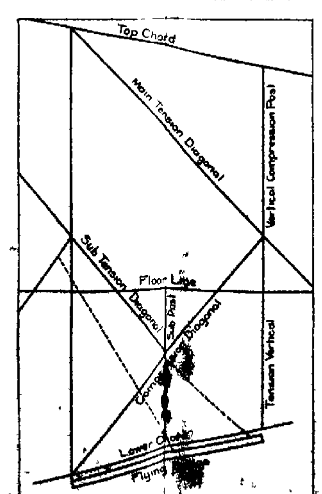


Diagram showing how members are erected

Ten huge members connecting to the main shoe center

The "flying bridge" being moved out to its second position

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

REVERSIBLE CUFF —S GERSON, care of Hartman & Levine 309 Broadway New York, N Y This invention relates to shirts and similar garments and provides a cuff of soft material and of doubled up type and arranged to permit of wearing the cuff reversedly or turned inside out thus allowing its use for a long time prior to laundrying it, or in case the original outer face becomes threadbare or torn

Of Interest to Farmers

POTATO PLANTER —A REICHERT Auburn Wash This invention provides a planter including a revoluble feeder wheel and mechanism for securely rotating or kicking the wheel at equal intervals, whereby the potatoes carried by the wheel will be deposited at equally spaced intervals in a delivering tube irrespective of the size of the potatoes so that they may be conveyed through the tube to the ground and uniformly planted at equal distances and depths apart

MANURE WAGON — B V CORNELIUS Route 1 Village Springs Ala The invention pertains more particularly to devices for distributing manure in the liquid form It provides a wagon having separate compartments one for carrying manure and one for water, the parts being so arranged that leakage from the manure mingles with the water and may be discharged therewith for purposes of fertilization

GRAIN SEPARATOR —H BUISSON, Fort Totten, N D This improvement relates to the separation of the bad from the good grains in agricultural activities and the main object thereof is to provide mechanical means for accomplishing this result It provides a machine for this purpose which is readily operated by hand, but which may also be power driven

COUPLING —G F WINTER, Lihue Mill Lihue Kauai, Hawaii This invention relates to sugar cane mills and provides a coupling more especially designed for coupling together the sections of the square driving shaft for the upper roller with a view to render the said driving shaft flexible to allow the upper roller to yield in case foreign matter pass with the sugar cane between the rollers

COMBINATION GRIT FOR FOWLS — H VON UFFEL, Prince George Hotel New York N Y This invention relates to a feed for fowls in the form of a combination grit in which the particles of grit proper are enriched with a certain fixed coating or covering of any suitable substance which is easily assimilated The coating may consist of a substance containing either a food or a stimulant or both

Of General Interest

WORK SUPPORT – MARY A. KEATING, 161 W 25th St., New York N Y This invention relates particularly to a device for use in the school room for acting as a support for sheets pencils, and objects to be drawn as well as other suitable articles It provides a supporting clamping member designed to be secured to a desk or other support which will resiliently clamp an article in place so as to hold the same in view continually

PROCESS OF PRODUCING SOLUBLE SALTS OF ALUMINUM —M P COOLBAUGH and E H QUINNEY Address Schrader & Lewis Rapid City, S D In this case the invention has reference to improvements in processes for producing soluble salts for aluminum from kaolin and other siliceous and argillaceous earths rocks, or minerals containing no potash in which compounds of aluminum exist in an insoluble form

PORTABLE STEEL BUILDING — J R ASHLEY 1790 Broadway New York N Y This invention reinforces a portable steel building structure balances the load carried by the roof stiffens the side wall construction of the building without materially augmenting the weight thereof cheapens the cost of construction and simplifies the labor of assembling the parts of which said building is composed

TIME EXPOSURE CALCULATING METER —W H EDMUNDS 23rd and Market Sts Denver Colo This meter is for use in connection with a photographic camera for calculating the time of exposure necessary to produce the best results under prevailing conditions The invention provides a device designed to be located in a particular position upon a camera the operation of the meter depending for accuracy upon its proper position on the camera

SELF FILLING FOUNTAIN PEN —W I FERRIS 171 Broadway New York N Y This improvement relates to self filling fountain pens and deals more particularly with operating means for the deflating presser bar for the ink sack Another object of the invention is to provide a novel inexpensive, and reliable spring for the presser bar

BOND MATURITY CALCULATOR —G H HEWITT Jr 60 Broadway New York N Y The invention relates to means for determining the terms which bonds, promissory notes, or the like have to run from the present date to the date of maturity, the primary object being to provide a device having relatively movable parts with data arranged thereon and adapted to indicate by a simple adjustment of the relatively movable parts, the number of years months, and days to the date of maturity

SUPPORT FOR CEMENTITIOUS MATERIAL —E FLAGG 109 Broad St New York N Y The invention relates to means adapted to form supports for cementitious material partitions while the same are in process of setting It relates more particularly to vertical supports which will carry the plastic mass, and which will permit the same to plumb under the action of gravity

PAPER BAG —S S STEIN, 8 W 38th St New York, N Y In the present invention the improvement has reference to paper bags and refers more particularly to handles therefor whereby a number of bags can be conveniently carried together without any danger of losing any of the bags or the contents thereof

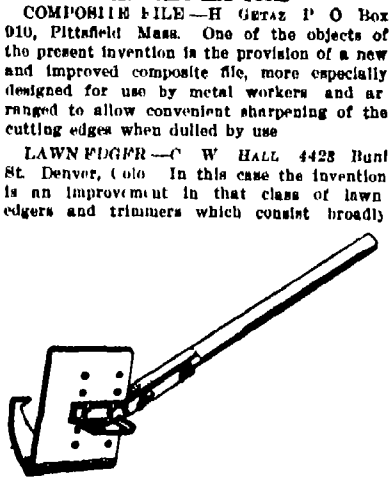
LEG SETTING DEVICE —M SCHNUG, Bonduel Wis The invention relates to portable means for setting a fracture of the lower leg of a human either right or left and the main object thereof is to provide such a device which may be readily assembled and unassembled whereby when not in use, the parts will occupy but small space

LIMB SETTING DEVICE —M SCHNUG Bonduel Wis This invention is designed for setting fractures of the upper leg or hip right left or both and in the reduction of which it is necessary to have the body elevated in order to be enabled to put a bandage or plaster cast around the leg, hip, or back, and at the same time to maintain the leg or legs under tension and in proper anatomical line

Hardware and Tools

COMPOSITE FILE —H GETAZ P O Box 910, Pittsfield Mass. One of the objects of the present invention is the provision of a new and improved composite file, more especially designed for use by metal workers and arranged to allow convenient sharpening of the cutting edges when dulled by use

LAWN EDGER —C W HALL 4423 Bunt St. Denver, Colo In this case the invention is an improvement in that class of lawn edgers and trimmers which consist broadly

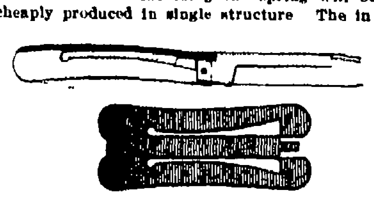


LAWN EDGER.

stated, of a curved blade secured to a handle and provided on one side with a lateral gage which runs on the curb or edge of the side walk and is adjustable vertically to vary the depth of cut made by the blade.

DENTAL APPLIANCE —T H RAGATZ, Prairie du Sac, Wis The invention has particular reference to a novel device for cleaning teeth It provides a rotary flexible container adapted to receive the cleaning material and to be placed over the tooth to be cleaned, said container being rotated by an endless flexible belt or cord

POCKET KNIFE —J F KNOWLTON, 1118 3d St. Hibbing Minn This invention relates to knives such as pocket knives including a handle or to be disposed in line with the handle for use It provides a knife the complete handle of which including the spring will be cheaply produced in single structure The invention



POCKET KNIFE

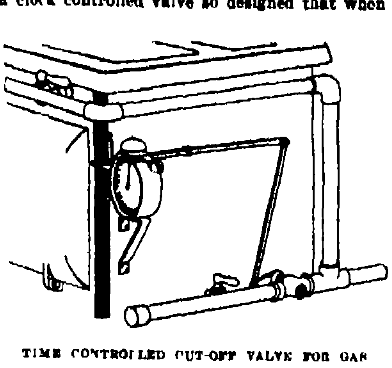
vention produces a single handle blank with members thereon to constitute the sides and spring and the blank is then bent and swayed to bring the side members into proper position with the spring constituting the whole back of the handle

Household Utilities

TOASTER. —G H CARLTON, Mason City, Iowa The invention relates more particularly to that type of toasters which embodies toasting plates having means whereby to support the same in superposed relation above a burner and the like on which bread is disposed for toasting the object being to provide means whereby the heat rising from the burner will be distributed over the entire lower surface of the toasting plate

IRONING BOARD —R B PALMER, 28 Gold St Norwich N Y This improvement refers to a structure having folding supports for the board the supports including braces pivotally connected at one end, and having means whereby to detachably connect the opposite ends of the braces, to variously adjust said braces whereby to vary the height of the board or adapt it for other purposes such as a bed-side table.

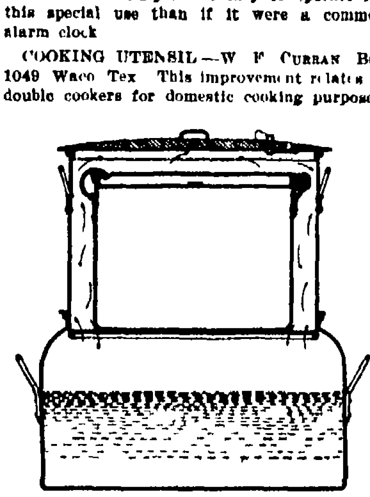
TIME CONTROLLED CUT-OFF VALVE FOR GAS RANGES —H. SIMES and J A. STELLER. Address the latter, 803 E. Walnut St., Bloomington, Ill This invention provides a clock controlled valve so designed that when



TIME CONTROLLED CUT-OFF VALVE FOR GAS RANGES

applied to a gas range it is possible to heat the range for a predetermined time and when the time limit is reached the clock will automatically effect the closing of the gas valve to stop the heating of the range The clock actuated mechanism is operatively connected with the cut-off valve, and is capable of being set for actuation after the lapse of a predetermined interval of time according to the food to be baked or roasted The timer or clock is more simple and easy to operate for this special use than if it were a common alarm clock

COOKING UTENSIL —W F CURRAN Box 1049 Waco Tex This improvement relates to double cookers for domestic cooking purposes



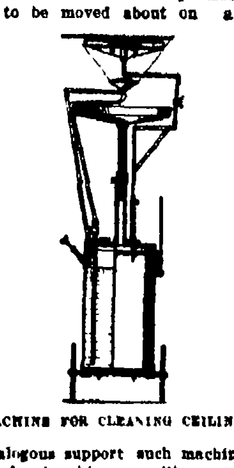
COOKING UTENSIL

The ordinary double boiler by reason of the wasteful escape of steam tends to dissipate the water in a short time and is liable also to boil over, so that the utensil requires constant attention The prime object is to provide a domestic double boiler, which may be used for continuous cooking for a long period, without replenishing the water supply

INSECT CATCHER.—S H. PATTERSON 121 N 21st St Philadelphia Pa Use is made in this invention of a funnel provided with a barrel, and having an air channel leading from the barrel to the edge of the funnel and a handled plunger movable in the barrel for forcing an air blast through the air channel to dislodge an insect on a ceiling wall or other support, and against which the finger is pressed

Machines and Mechanical Devices

MACHINE FOR CLEANING CEILINGS — S GOTTLIEB care of Sackler and Lavitt, 257 Broadway, New York, N Y This improvement provides a machine of a portable nature adapted to be moved about on a floor or



MACHINE FOR CLEANING CEILINGS

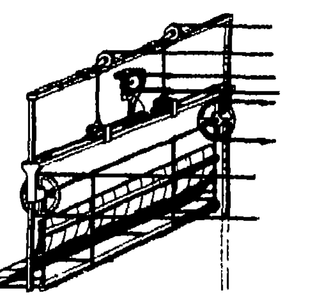
other analogous support such machine having facilities for brushing a ceiling or sweeping dust, dirt, cobwebs, or the like from the same by means operable by the operator standing on the floor

SUBMARINE TORPEDO DISCHARGING DEVICE —H W HILLS, 306 Wells Fargo Bldg New Orleans, La This invention provides a means whereby a torpedo or bomb may be discharged when the submarine moves into close proximity with its target, so that there will be no danger of the torpedo or bomb missing its objective. It provides a means of such a nature that a torpedo may be readily inserted within the tube from within the submarine and while the same is submerged.

WHEELED SCRAPER.—O. P HALLOCK. Address M. V Liddell, 1408 South 8th St., Springfield, Ill. This invention has particular reference to machines for excavating and conveying the excavated earth from the point of excavation to the point of deposit While this machine is particularly adapted for road making purposes, it is by no means to be limited to any particular art.

AUTOMATIC JOINTER —G E. TOMLINSON, Winchester, Ky This invention relates to woodworking machinery, and has particular reference to edge trimmers or jointers. It provides a machine for jointing the edges of staves for barrels or hogsheads so as to joint both edges of pieces or strips of lumber of random width automatically or in a continuous operation

WAVE MOTOR —K. FOUSEK 505 East 9th St. Austin Tex This invention provides a wave motor which includes an apparatus installed in a wave disturbed liquid and a power



WAVE MOTOR.

converting mechanism connected thereto by flexible elements and adapted to convert the energy received therefrom into such form that it may be conveniently utilized It provides a wave actuated buffer plate in the path of motion of the waves, and so mounted that it may be raised or lowered and locked at any intermediate position all of which is under control of the operator located at some distant point

SEWING MACHINE —J PARTMANN, 38 W 3rd St, New York, N Y This improvement provides a compact sewing machine in which the lever has two arms extending from its fulcrum in the same general direction, one of the arms being connected with the driving shaft by a link and cam, and the other arm serving to operate the needle bar

CHECK CONTROLLED DEVICE —S F MIOTON, 2523 Esplanade Ave New Orleans La The invention relates to coin or check controlled devices, and is designed especially for use in connection with the automatic gasoline service disclosed and claimed in a former Letters Patent granted to Mr Mioton The invention provides a mechanism which is peculiarly adapted for detecting bogus or bad coins or checks which are too heavy or too light

SOUND CONTROL FOR TALKING MACHINES —V W WECZERZICK 857 Union St Brooklyn, N Y, N Y This invention provides a device for controlling the volume of sound arranged in the gooseneck of the talking machine or at some other convenient point in any part of the quantity or volume of sound tube, whereby the tone is affected according to the movement of the controlling device

AUTOMATIC RETURN CHECK AND STOP VALVE —T B FORD, 40 Broome St, New York, N Y This inventor's object is to provide an automatic return check and stop valve used in steam pipes and arranged to prevent sticking and chattering to dispense with the dash pot, to permit convenient adjustment for operating at slight differences of boiler and main pressures, and to provide a visible means for the attendant in charge to see whether the valve is properly working or not

PIPE SADDLE — J G HAYDEN care of Flora Water Co., Flora, Ind Mr Hayden's invention relates to a form of pipe saddle adapted to pipes of different diameters The invention eliminates the objections inherent to the old form of saddles and provides a connection which is absolutely tight, irrespective of the size of the pipe or the inequalities of the surface of the same

HYDRAULIC VALVE —W L MARSHALL, Washington, D C The inventor provides a hydraulic valve which allows the greatest possible discharge with the least weight of material in the moving parts, with the least motion and friction, and with forces acting on the valve which are balanced or in equilibrium in every direction and at every position of the valve

Prime Movers and Their Accessories

FUEL HEATING DEVICE FOR INTERNAL COMBUSTION ENGINES.—L. A., E. T & E. L. STRAUBEL. Address Straubel Machine Co., Green Bay, Wis. The invention provides means whereby the fuel supplied to an inter-

(Concluded on page 484)

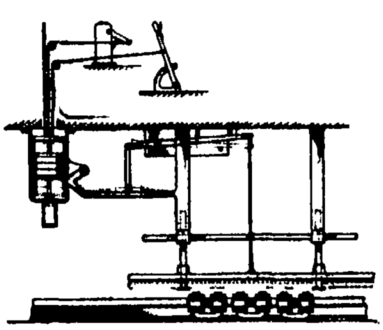
(*Concluded from page 482*)

nal combustion engine may be heated to a high temperature before introduction within the working cylinder, and without producing an amount of friction in the passage of the fuel as would tend to destroy or impair the free circulation thereof.

CARBURETER.—D CAHILL, 108 Quai de Courbevoie, Courbevoie, Seine, France. The invention relates more particularly to those of the type wherein a choking member operated by hand and controlling the admission of the mixture of air and liquid fuel to the combustion chamber of the engine, is connected with a similar choking member designed to vary at the same time the sectional area of the passage for the air only or both the sectional area of the air passage and that of the passage for the fuel

Railways and Their Accessories

AUTOMATIC TRAIN STOPPING DEVICE. —O H ENNIS Derby Conn This inventor provides magnetic means for stopping a train in which there is no actual contact between the devices carried by the engine and those



AUTOMATIC TRAIN STOPPING DEVICE

distributed along the track He provides a device in which the magnetic devices distributed along the track act upon an armature in such a manner as to release a weight the release of the weight serving to actuate the throttle lever the brake lever to blow the whistle or to actuate electrical mechanism for the controlling of the motor in case electricity should be used instead of steam

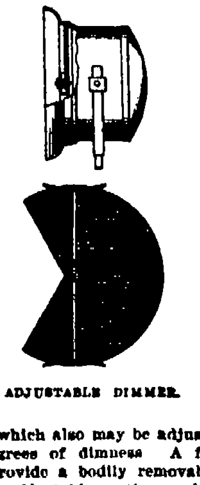
REINFORCED LOCOMOTIVE DRIVING BOX SHOE —J C LYONS P O Box 735 Mc Comb Miss The improvement is in reinforced locomotive driving box shoes, and the invention has for its object to provide a shoe of the character specified wherein steel reinforcing plates are cast on the shoe to strengthen and reinforce the same to prevent damage in use

GONDOLA CAR T H WATTS 106 3rd Ave Altoona Pa The invention provides an apparatus which embodies a construction for retaining the pivoted doors of the car in closed position and which when operated will greatly facilitate the opening and closing of said doors the mechanism for such operation being so arranged that substantially a third of a complete revolution of the operating crank is all that is required to open or close the door

Pertaining to Vehicles

OIL RING—W J FRANCKE New Brunswick N J This improvement relates to oiling devices for shafts or other revolving elements of high speed motors and other machines and devices. It provides an oil ring arranged to permit of conveniently placing it in position in the bearing and on the shaft or other revoluble part without disturbing the same

ADJUSTABLE DIMMER — E W BRANDQUIST 48 Berwick St Orange, N J An object in view in this case is to provide a dimmer for lamps especially of the automobile type which may be quickly applied and re



ADJUSTABLE DIMMER.

moved, and which also may be adjusted to give different degrees of dimness A further object is to provide a bodily removable dimmer formed with adjustable sections, whereby part of the lamp may be dimmed and the remaining part left uncovered.

TRACTOR VEHICLE —J A MONTGOMERY and H HANSEN Address the former, Ukiah, Cal This invention relates to traction vehicles and has particular reference to tractor wheels having an endless flexible belt tread and a main load supporting wheel coöperating with the said tread An object is to simplify and generally improve this class of devices in respect to the reliability of operation and durability

LANTERN HOLDER.—J. E. BASHMAN, Pittsfield, N. H. This invention relates to means for holding an ordinary lantern on a vehicle to constitute a vehicle lamp, so that a separate headlight of special construction will not need to be employed on the vehicle, and the ordinary lantern employed for the purpose will be available for its ordinary uses when detached from the vehicle.

PNEUMATIC TIRE APPARATUS.—G E. BATCHELLER, 1612 Broadway, New York, N Y An object here is to provide a means for furnishing a pressure fluid for the flexible inner bag for coöperating with the aforesaid apparatus, the operation of which is thoroughly satisfactory and whereby a vastly larger number of cures may be had from a single pressure fluid bag than may be had by the apparatus commonly in use.

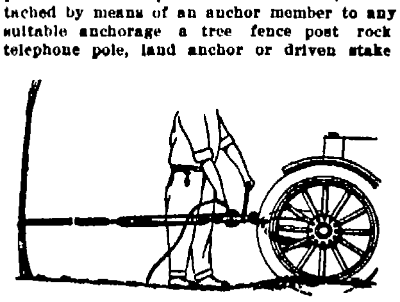
VEHICLE HOIST —L. TOWNSEND, Flat B, 117 Cherry St., Evansville Ind. The invention relates more particularly to hoisting means whereby an automobile can be raised slightly from the ground. The object is to provide a vehicle hoist which can be easily adjusted to various lengths of vehicle wheel bases and whereby the height to which the vehicle can be raised can be also adjusted

VEHICLE TIRE —J T FITCH, Helper, Utah The invention relates particularly to tires for motor driven vehicles, and provides a substitute for the conventional pneumatic tire which is of no greater initial cost of very low maintenance cost which prevents accidents now due to blow-outs, which enables repair of any required portion of the tire without removing the tire entirely from a wheel, and which possesses all the advantages of the pneumatic tire without any of its disadvantages

RESILIENT WHEEL — T T CHALONER, 540 W 47th St. New York N Y This invention provides a construction which gives the desired resilient effect both radially and laterally It provides a resilient wheel with a radial resilient structure and resilient bracing members so that the tread portions of the device may yield substantially in any direction for accommodating the wheel to different conditions of road

TRUCK —A D COX Box 14, Winterville N C This invention relates to an improvement in trucks and provides an improved truck which may be readily handled by a single person in transporting farm products particularly from one place to another, and which may be readily loaded and unloaded

AUTO PULLER —J W LA VAKE, Eustis, Fla For use in pulling an automobile from its stalled position the puller which is so compact it can be kept in the automobile, is attached by means of an anchor member to any suitable anchorage a tree fence post rock telephone pole, land anchor or driven stake



AUTO PULLER.

A hook is passed through or around some substantial part of the automobile and secured thereto by an engaging hook through a link Means provide for taking several bights of a cable passed around a drum The operator then grasps the free end of the cable with one hand and with the other, through a crank, a shaft and certain gears actuates the drum This causes the two blocks to approach each other and hence the speedy extrication of the machine

Designs

DESIGN FOR A BODY FOR ELECTRIC FIXTURES —S SHAPIRO, 15 Laight St., New York N Y The fixture has a body formed with a large bulged central portion from which extends a bead which in turn, has a rounded upper portion terminating in a stem A ring shaped section extends from the bulged portion, and is bent to form a recess and a downwardly projecting conical portion, which in turn, has projecting therefrom an inverted cup-shaped bottom

DESIGN FOR AN ARTICLE OF MANUFACTURE.—C. BASTOW, 25 Madison Ave New York, N Y The design comprises a perspective view of New York city looking from the bay showing the Statue of Liberty, the East River bridges and conspicuous features of the city At the corners are floriated panels and above and below there are chain borders. At one end there are views of the U S Sub-Treasury and Grant's Tomb, each in a floriated oval panel.

DESIGN FOR A DINING TABLE FIXTURE —I TIOSE, Ferndale, N Y This design presents a circular base from which a vase-like holder rises centrally together with a series of smaller auxiliary holders rising from lateral arms and terminating short of the top of the central holder, there being on the arms outwardly disposed horizontal opposed semi-circular members.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

How May the Permanent Success of Our Dye Industries Be Secured?

(Concluded from page 473)

Can such revolutionary conditions be brought about? "Yes," but only by patient and persistent campaign of education with the consumers, the public and the manufacturers, for there is yet much for the last to learn. He must learn something of the methods of the foreign manufacturer, to whom there is no such thing as waste, where everything is utilized.

Too many American manufacturers are allowing millions of dollars to be wasted in the air or down the sewer because they have not learned how to utilize all their material. The European manufacturer on inspecting an American chemical works is apt to have heart failure on viewing the almost criminal waste of material, labor and dollars. Only time can change these things. In the interim the manufacturer must be helped, encouraged and educated.

Esprit de corps alike among the manufacturers and the consumers, must be firmly established and a patriotism now absent must be engendered in the hearts of the whole people. These can best be done with the coöperation of our Federal Government, that has at its command, not only able, willing and untiring experts, but the most complete compilation of data, valuable alike to the manufacturers and to the consumers.

Finally, this campaign, already started by the Bureau of Foreign and Domestic Commerce, must be pushed on vigorously in all directions, for there is no work in our whole Federal system comparable with the prosperity of its industries, else we may be confronted with a situation the newer manufacturers already fear and are tentatively preparing for, the necessity of abandoning the manufacture of dyes, intermediates and colors through want of support. These industries will not fail, if they do fail, because of lack of capital, enterprise, genius or earnest desire, but because of the failure of the consumer and the whole people to appreciate the opportunities and privileges offered to coöperate in making this the greatest nation in the world by giving it commercial supremacy.

War Game—VIII

(Concluded from page 476)

be fully utilized. Before attempting to go into the details of this phase of the war business, let us see what is the most important duty of the victorious forces.

Tactics, strategy and the whole military organization is built up on the desire to destroy the enemy army. This means to kill to disable, to take as prisoners the enemy soldiers, to destroy, to burn or to capture the enemy artillery ammunition, or any other property. Simple and ancient ideas which have never changed since the first war.

This understood, we might consider the methods of present-day tactics to accomplish the above aims.

It must have been apparent from the war correspondent's report that, while Lieutenant General LM was in the tower anxiously awaiting the outcome of the combat, he has no means left to influence it to any great degree. He has made his plan and put it into action, then he must wait to see the outcome of his arrangements.

A slight deviation from the pre-arranged plan might have caused an entirely different result, as far as the final outcome was concerned. Now his efforts have been successful. His preparations have borne fruit. Now it is his duty to take a hand again.

The first thing to do, after the successful assault by the infantry, is to reorganize these forces. With the converging assault and the different forces, the line will not be a unit, but a mass of intermingled troops. Nevertheless, if well trained, these troops will form a firing line as soon as the enemy position is taken. Usually they will not take cover, but will fire standing or kneeling, for, if the enemy is forced to a hasty retreat, there is very little chance to receive enemy fire. Very

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Give your vacation to your country

and still have the best vacation you ever had

The Military Training Camps at Plattsburg and elsewhere last summer were a great success

Over 4,000 men, many of them prominent, rich, successful, left businesses, or gave up vacations, and were well repaid.

They learned enough of military service to be valuable to their country in case of war Their vacation benefited them mentally and physically

This summer you have an opportunity to do the same thing Will you do it?

Fifteen Camps at Seven Points

Every man who is willing to make this splendid sacrifice will now have full opportunity

Camps have been established at the following points

Plattsburg, New York—June, July, August, Sept.
Fort Oglethorpe, Georgia—May, June, July.
Monterey, California—July
Salt Lake City, Utah—August.
American Lake, Washington—August.
Ft. Benjamin Harrison, Ind —July, August, Sept.
San Antonio, Texas—June

There will also be a camp for boys between 16 and 18 at Plum Island, L. I New York in July

Practically every able-bodied man of good moral character, between the ages of 18 and 45 years, is eligible Plan now to spend four weeks this summer at the camp nearest to you. You will enjoy a clean, healthy, active life in the open air, with work enough to make you tired at night and hungry at meal times You will associate with men like yourself who are alive to the needs of your country, and who are leaders in this work because they are leaders in everything they undertake

Richard Harding Davis

who "did his bit" at Plattsburg last summer, said

"The business men who to my mind are really successful are those who left office and home, if only for a month, to carry a pack and to sleep on the ground at Plattsburg They enrolled, not because they are crazy for war, but to prepare against war, to assist our government in preparing against it, to make war impossible, to insure peace"

The Expense Is Small

The War Department furnishes tents, equipment and arms United States Army officers instruct and drill the men The board, $25 00 for the four weeks, uniform $12 80 (not including shoes), and railroad fare are all that you will have to pay

Where else, for so little money, can you get camping, outdoor life, plenty of exercise (rifle practice, hiking, swimming), first-class food and good fellowship?

The Reward Will Be Great

Every man will spend at least four weeks in the camp He will learn as much of modern military science as can be taught in that time Those in charge are commissioned officers of the United States Army, and they know their business Association with them and with your fellow volunteers will be an experience you will look back to with pride and pleasure the longest day you live

Camp life is hard work, but exhilarating Every man who went to Plattsburg feels that it was worth while as an outing, even if the good time had not been sweetened by the thought that he was doing his duty

Employers Are Coöperating

Many of the largest businesses in the country are making it possible for their men to attend these camps They are giving every man who is willing to go four weeks' vacation and full pay, without jeopardy to his position and future advancement Every one is doing his part. Will you do yours?

Write for full information, descriptive booklet with pictures by the best known artists, and enrolment blanks

Plan with your employer or your partners or your subordinates to be away for four weeks this summer

Persuade every man of your acquaintance that he should go also

Military Training Camps Association
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OR
Officer in Charge, Military Training Camps
AT

Headquarters Eastern Dept
GOVERNORS ISLAND, NEW YORK

Headquarters Central Dept
CHICAGO, ILL.

Headquarters Southern Dept
SAN ANTONIO, TEXAS

Headquarters Western Dept.
SAN FRANCISCO CAL.

Federal Training Camps
Under the instruction of U.S. Army Officers

Pictures taken at Plattsburg

Photos by Thompson Photo Co.

likely, enemy artillery fire will be directed on the lost line, but this must be considered only after attending to other more important matters.

With well trained forces, the last reserves thrown into the line to carry forward the assault will be in the best formation for the pursuit These troops must start out immediately and pursue the enemy, unless reserves are at hand who have not been used. In our present case, the pursuit will be difficult on account of the forest, which offers a good shelter and an easy retreat for the enemy

As soon as a force is started on the pursuit, no time should be lost in reorganizing the rest of the troops. They should be reformed if possible into their original units under their own officers and a relentless pursuit should be carried on to the finish

It is extremely important that the victorious forces shall not remain longer than is absolutely necessary in the newly acquired positions

The enemy artillery is sure to shell their old position with great accuracy knowing the exact distance

The next important step is to move our artillery forward, to have it always on hand in case of unexpected events

Under the given circumstances, there seems to be very little chance for a counter attack but a good commander will never leave a single thing undone The squadron of Blue cavalry should be sent to keep as close a touch with the enemy as possible In this case it is their duty to harass the retreating columns by attacking and cutting off stragglers, thus securing more prisoners.

This completes the problem which began in the First War Game, printed in the issue of March 11th, and has shown the readers through the most vital tactics in field service

Penetration of the Enemy's Line

General Situation

A western Red detachment, consisting of five battalions of infantry, two squadrons of cavalry, one and a half batteries of artillery and a company of engineers, after an unsuccessful engagement on the 12th of June, 19—, at Bristol, retired directly west, closely followed by Blue cavalry patrols

On the 13th, this detachment reached Pottstown

At 3 30 P M, General G receives from Division Headquarters at Wyola, the following order

Division Headquarters,
Wyola, June 13 19—, 12 30 P M

Large invading enemy forces are slowly moving toward Pottstown with the evident intention of seizing factories there and in Deansville

To hinder this advance intrench from the Neshaminy Island bridges south with right resting on Conestoga Creek Consider the dams south from Manor and utilize the creek for securing your right flank.

Our 4th Division is holding the river line north of Neshaminy

Reports should be sent to headquarters where I shall remain

GENERAL LG

General G, whose rear guard has halted at the southern edge of the small woods south of Pottstown, immediately mounted his horse and accompanied by his staff rode out to inspect the territory

This inspection gave him the following general ideas

There is level ground, with good and clear foreground to be defended

The construction of a dam at the Conestoga bridge by the engineers will inundate the swampy land and eventually the whole low territory south of dams.

This will give a strong front to defend and, by utilizing the barbed wire fence nearby to build obstacles before the trenches, it could be still more improved.

After considering these matters he gives the following order to the waiting adjutants

Superior enemy forces are slowly moving west Their aim is Pottstown and Deansville. To hinder their advance, the detachment will entrench on this line (he points it out) from these bridges south to creek. Fire trenches to be built by 1st, 2d, 3d Battalions and communicating trenches by 4th and 5th Battalions. The artillery will prepare and mask a position behind Ash Inn.

First platoon of engineers will dam up Conestoga creek at road bridge. Second platoon will construct from available barbed wire in front of the trenches.

Second squadron to move east and to reconnoitre as independent cavalry. First squadron to advance to Norrisville and protect our right flank

A screen of infantry patrols to be sent out.

Headquarters City Hall, Pottstown, where I shall remain

The adjutants carry these orders to their respective commanders and the machine begins to work out General G's order

Through the efforts of a spy, these orders were copied and a day later, on the 14th of June, 19—, at 10 A.M, were in the hands of Brig Gen. LG, at the moment when his detachments' advance guard has reached Ferguson Farm on the Eden Norrisville road

Brig Gen. LG's detachment consists of two regiments of infantry, one regiment of cavalry, two batteries of artillery and one platoon of machine guns.

At 10 15 A.M, he receives the following report from a cavalry patrol

N W Corner Paoly Forest, opposite cemetery June 14 19—, 8 20 A M The enemy apparently a brigade strong is entrenched between Pottstown and Conestoga Creek on level land

There seems to be no sign of artillery

I shall remain in observation

Lieutenant L, 2nd Cavalry

Five minutes later

Goat Hill No. 62, June 14, 19—, 8 30 A M

After an encounter with enemy patrol, which we have dispersed and made two prisoners, I have observed enemy entrenched south from Pottstown to Conestoga Creek.

Artillery positions are masked in small wood before Ash Inn.

The whole territory south of Goat Hill is inundated and impassable.

I shall remain here in observation.

Lieutenant FL, 2nd Cavalry

Brig Gen LG has received orders that Pottstown and Deansville are to be secured at any cost.

All this demands one action, a frontal attack with an attempt to penetrate enemy's line

The territory in which these operations are to be carried out is rather advantageous for the Blue forces. There are fine artillery positions at hand, also a chance to approach effective range through the forest.

Question

Question 1 Brig Gen. LG has made up his mind to attack enemy and to break through his trench line at the small woods directly in front of western edge of Paoly Forest. When will he issue his order?

Question 2 What will be his order to effect this operation?

Question 3 What influence will the inundated territory have in regard to his left flank?

Question 4 The whole regiment of cavalry is sent ahead to Norrisville to attempt a flanking maneuver and to reconnoiter farther west What will be Colonel C's (of the cavalry) order?

Answers to Questions in War Game VII

Question 1 See map

Question 2 See map

Question 3 Major M's detachment on the two river boats will reach the landing point between 1 and 2 o'clock in the morning But, considering the difficulties of landing his two battalions without a pier, it will be 5 o'clock in the morning before the two battalions will be in column of march

Question 4

On board River Boat—date—

The enemy, two regiments strong is facing our forces on the northern slope of Lookout Hill,

We shall land at the river bend near large pine tree and envelop the enemy left flank.

The engineers will assist in the landing.

1st Battalion to land first and to provide security for the detachment.

We shall march north at 5 30 A M

I shall march with advance guard.

Question 5 It will move north in secured march, then, at the command of Major M, front toward west. In this way the deployment will be quicker

Question 6

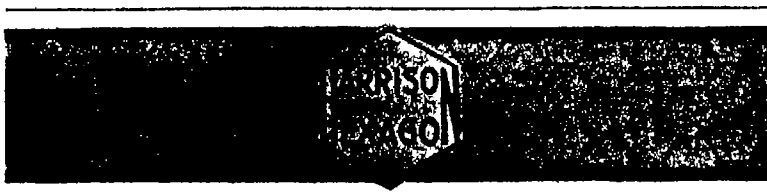
The enemy is in close contact with our main forces. Patrols 1, 2, 3 and 4, advance under cover to crest of Chester Hill, and remain there in observation.

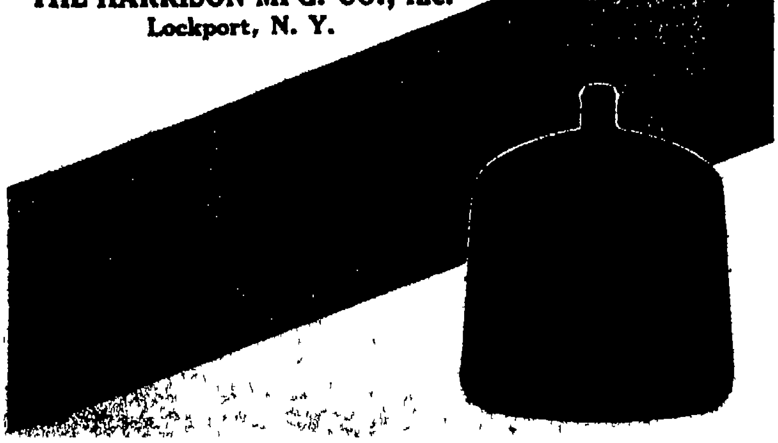
Reports to be signaled to main column.

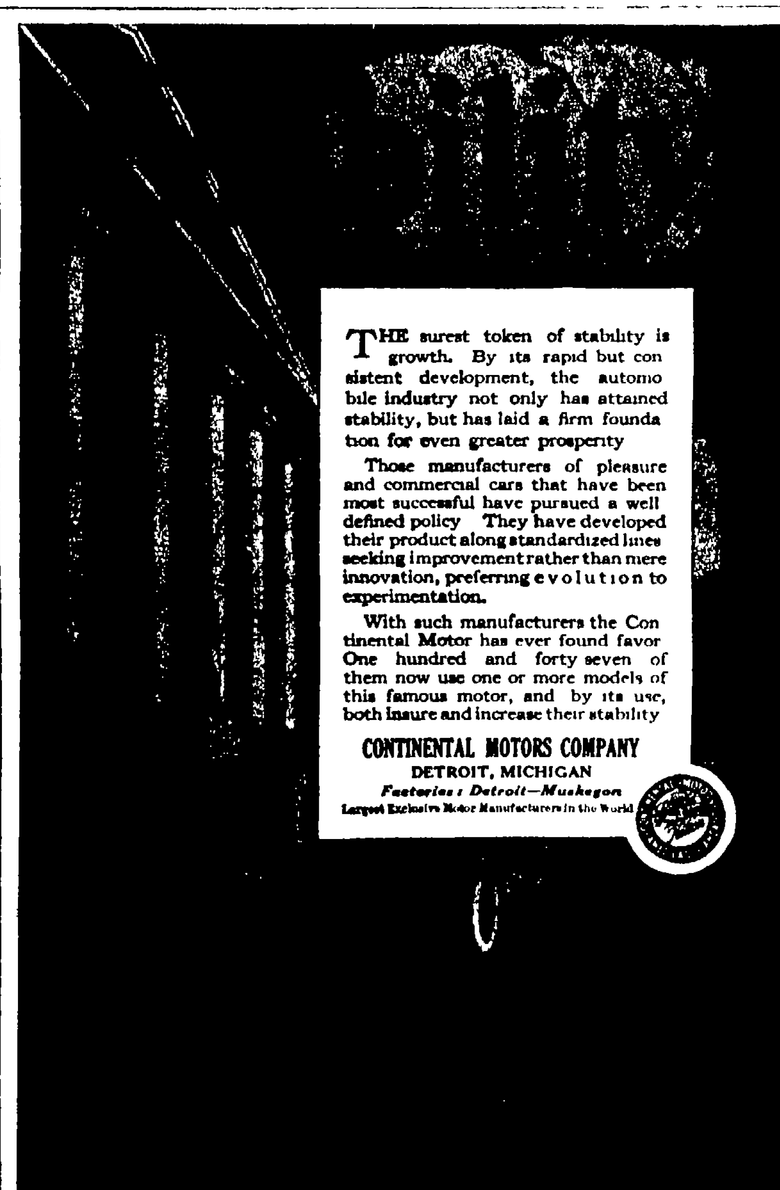
Question 7. The detachment did not reach crest of Chester Hill till 5.55. All this time they could hear the crackle of rifle fire and the booming of artillery Once the enveloping detachment reaches the position where the attack can be carried out, Major M, after explaining the situation, will give the following order:

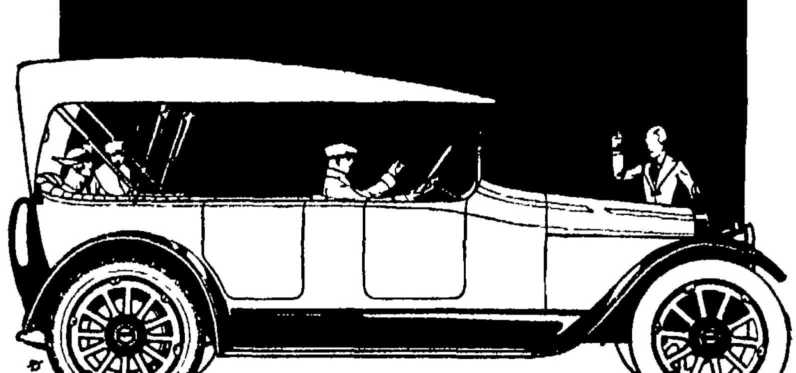
We will attack the enemy's left flank along Indian Creek.

The 1st Battalion will advance against the









enemy's line in the direction of the Lone House.

Second Battalion, as reserve, will follow behind the center. I will be with the reserve.

[*The first of this series of War Games began with the issue of March 11th. A war map in colors, covering the terrain of these War Games, was published in the issue of March 25th. Copies of this map may be had for 10 cents each.*—EDITOR.]

Cartridge Cases of Steel

(Concluded from page 478)

The present American service rifle develops a chamber pressure of about 50,000 pounds per square inch. The German Mauser goes nearly to 60,000. Because of the rimless case used and the form of the bolthead, the case is not solidly supported during firing, but it is free to flow out around the bolthead when the pressure gets high enough to make brass flow.

In the American service rifle, when the pressure gets up beyond 60,000 pounds per square inch, the first sign of trouble is the dropping of primers from the cases, caused by the shell flowing sideways around the head and enlarging the primer pocket. Sometimes this allows gas to get into the bolt mechanism and blow the striker to full cock. A number of rifle men, holding their heads close to the firing pin and wearing glasses, have had their glasses broken by the sudden rearward thrust of the firing pin from the escaping gas.

Still higher pressures rupture the brass case at the groove or cannelure, and this may blow open the rifle if the gas gets out at the right spot to lift off the top of the receiver and release the top locking lug of the bolt cylinder. The first sign of too high pressure, as I say, is the flowing or stretching sideways of the brass case at the head. However, rimmed cases, solidly supported by most carefully machined blocks, extending all round the rim and not allowing the brass to flow in any direction, have stood chamber pressures of 80,000 pounds per square inch. This is an impossible form of construction with the rimless case of the modern military rifle, and the necessary tolerance allowed in economical machine manufacture.

So much stronger is the locking mechanism of the modern rifle, and so easy is it to make this still stronger if necessary, like the interrupted screw form of bolt head used on the Canadian Ross rifle, that we may say that the brass case is the weak point of the modern rifle. Both from the standpoint of economy and of strength the steel cartridge case would be desirable if we can make steel function through the draw presses with the facility of the brass cup. The very fact of the ductility of the brass in the draw press is what makes the same brass yield to high powder pressures. It is evident that if we are to gain ground in this department, add strength to the case, we must be prepared to machine some material or other which is also less amenable to the blandishments of the press. Steel is immensely more economical than brass, which is largely copper. The economy may disappear if the speed of machines has to be cut down and the wear on the tools becomes excessive and the reloading of the cases becomes impractical through the rust, and corrosion through powder residue.

But regardless of the economical side of the argument, if we add strength to the rifle and permit of still higher pressures and ergo higher velocity, steel cases would be worth while. And, if through some such calamity as has befallen Germany, the supply of copper is cut off, then making cartridge cases out of steel is greatly to be desired even though no other advantage be gained than that of an unlimited supply of raw material.

Some years ago there came reports of German and French experiments with steel for cartridge cases, while I have before me samples of cases of this material made experimentally by Sir Charles Ross, of the Canadian national rifle factory. Nearly a year ago, the Ordnance Department of the United States Army undertook the [illegible] cartridge cases, [illegible] the consideration [illegible], the [illegible] [illegible] of copper or [illegible] [illegible] regular basis, but [illegible] made on the regular machines set up for the manufacture of the brass cases to demonstrate that the steel cartridge case is entirely practical. One is led to wonder whether Germany has not found the process practicable, or whether her shortage of copper is not so great as it is reported to be.

At the American Frankford Arsenal of the Army they made both steel service rifle cases and the clips to hold the five cases together as they are issued to troops. The Chief of Ordnance of the Army reports as to this work:

"Two thicknesses of sheet steel were used, the steel being planished on both sides. The cups were made without difficulty on draw presses, using the same punches and dies as are used for cartridge brass. Annealing after each operation was essential, and special precautions had to be taken to prevent scaling, by annealing in boxes packed with iron filings. The ordinary speeds of machine were used as it was not desired to make any extensive changes, but this resulted in considerable loss on account of scratching by the dies.

"For permanent manufacture the speeds would undoubtedly have to be very much diminished. Great care had to be taken with the lubricant, only the very best quality giving good results.

"As might be expected, a number of modifications in the amount of the annealing were experimented with. The earlier cases were defective in that there was a swelling of the head sufficient to cause leaks. Experiments were conducted only far enough to determine the practicability of the process and to overcome evident defects in order that the department might have the necessary knowledge to quickly undertake the manufacture in quantity, if desired."

Sample cases from Frankford, before me, show work of the highest quality, the cases being as uniform in wall thickness and head as the best made brass cases. The lightness of these cases is noticeable as compared to cases of brass, for the same rifle.

Steel cases would of course offer some difficulties outside of those of manufacturing. A protective coating of some sort would seem essential to prevent rust from perspiration from the bodies of the soldiers, and from the rain and dew to which soldiers are exposed. Their behavior in a rifle is still a matter of conjecture, but extraction should be easier and there should be less chance for the occasional clean rupture of the case in the chamber of the machine gun, leaving the forward part in the gun and putting that piece effectively out of commission until it is removed with a special tool.

It is not at all improbable that the Germans have not found practical what the Frankfort Arsenal has been able to do without much trouble. The German never yet has equaled the quality of the ammunition turned out from this Government arsenal, and the German never has turned out powder equal to the latest product of the American Du Pont Co., the progressive burning variety. Despite his painstaking thoroughness, it is not the Teuton alone who makes improvements in war material.

The New Quebec Bridge

(Concluded from page 481)

bracing, followed by the lower sections of the compression diagonals with their sway bracing. The subtension diagonal was then erected and the pins connecting it to the compression diagonal and the main "K" point were driven. The sub-post carrying the floorbeam and the floor-beam itself were next placed and the floor system from the main panel point to the sub-panel point laid. The traveler was then advanced until the front legs rested over the sub-panel point. In this position the second panel section of the lower chord was placed on the [illegible]. The upper [illegible] diagonals with their [illegible] [illegible]

Bad for the Cow, You Say?

That's true You may have to pay for it—that is, if you live to face a farmers' jury It seems incredible that, with much at stake, men who own cars or have trucks running around will take chances by buying any old kind of a brake lining Perhaps the only time they think about it is when they're in a pinch—in danger—and the brake lining doesn't grip **Friction—friction,** but there is **no** friction Now try the other way—equip your car with

Thermoid
HYDRAULIC COMPRESSED
Brake Lining - 100%

Thermoid is all friction—100% friction—from surface to surface—through and through **—all friction.** That's the kind of Brake Lining that will grip and hold your car

Thermoid is made of high grade long fibre Canadian Asbestos, spun on brass wire. Woven into cloth, thoroughly impregnated with a friction compound, folded, stitched, then hydraulically compressed in one single solid mass. Thermoid has "body"—substance—wearing qualities. It's there with the friction until it is worn to paper thinness. Tell your supply or garage man you **must** have Thermoid

Our Guarantee:
Thermoid Brake Lining is absolutely guaranteed to give more satisfactory results and to outwear any other lining manufactured Not affected by heat, oil, water, gasoline, or dirt.

Thermoid Rubber Company
TRENTON, N. J.
Makers of Nassau Tires and Thermoid Radiator Hose, Garden Hose etc.

Big Saving in Heating Costs Brings Order For More KEWANEE Smokeless Boilers

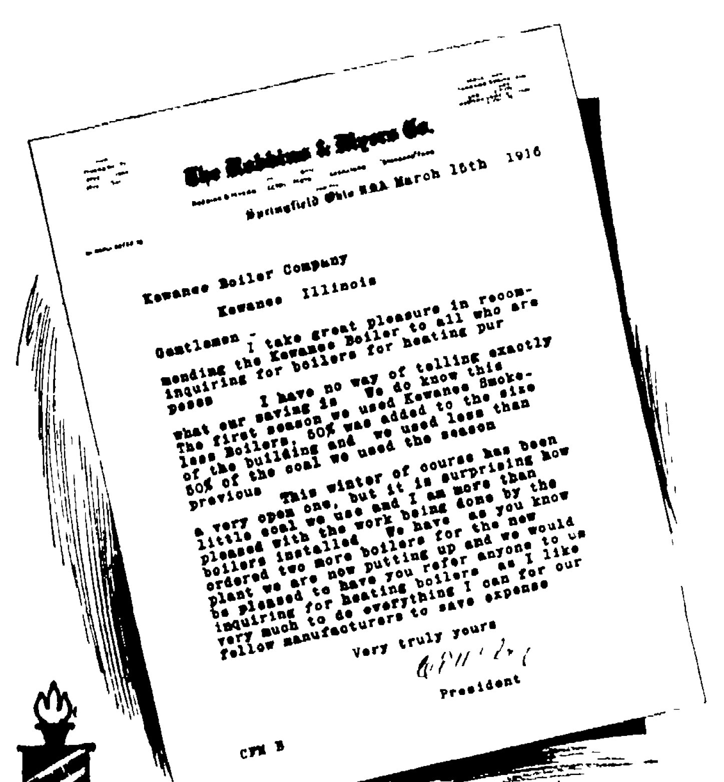
Office building and plant of Robbins & Myers Co, Springfield Ohio The world's largest exclusive manufacturers of small electric fans and motors. Four story building in foreground heated with two Kewanee Smokeless Boilers each capable of heating 17 000 square feet of hot water radiation W K Russ, Indianapolis Architect Hayes Bros Inc Indianapolis Heating Contractors Snider & Rotz Consulting & Erecting Engineers, Indianapolis designed the heating system

The Robbins & Myers Co. kicked the old heating boilers out of the four-story building (shown in the foreground of the above picture) and installed two Kewanee Smokeless Boilers.

In spite of the fact that the size of the building was increased about 50 percent the Kewanee Smokeless Boilers required *less* coal to heat the building than was used the previous season in the old boilers.

This saving in heating costs made by Kewanee Smokeless Boilers caused them to buy two more for a new building.

Read the letter written us by the president of the Robbins & Myers Company reproduced in this advertisement.



The Robbins & Myers Co.
Springfield Ohio U.S.A. March 16th 1916

Kewanee Boiler Company
Kewanee Illinois

Gentlemen -
I take great pleasure in recommending the Kewanee Boiler to all who are inquiring for boilers for heating purposes I have no way of telling exactly what our saving is We do know this The first season we used Kewanee Smokeless Boilers, 50% was added to the size of the building and we used less than 50% of the coal we used the season previous This winter of course has been a very open one, but it is surprising how little coal we use and I am more than pleased with the work being done by the boilers installed We have as you know ordered two more boilers for the new plant we are now putting up and we would be pleased to have you refer anyone to us inquiring for heating boilers as I like very much to do everything I can for our fellow manufacturers to save expense

Very truly yours

President

CPM B

KEWANEE BOILER COMPANY
KEWANEE, ILLINOIS
Steel Heating Boilers, Radiators Tanks, Garbage Burners
Chicago New York St. Louis Kansas City Minneapolis Pittsburgh

the rear of the traveler. The main tension diagonal with field splices completely riveted up was then hoisted into position and the pins driven. This was followed by the tension vertical, the vertical compression post and the supporting trusses with top chord eyebars in the order named. The top chord pins at the shore end of the panel were then driven, and the last truss pin connection was made by jacking up the bottom chord from the "flying bridge" and driving the pin connecting the tension vertical at the "K" joint. The erection of the sway bracing for the tension vertical, the floorbeam connecting to the tension vertical, and the floor system from the sub-panel point to the main panel point followed immediately The traveler was then moved out into position to repeat the operation for the next panel.

The work done on the south shore during the season of 1915 was as follows

The south shore traveler was completed by June 1st. The inside staging was then taken down on the north shore, transferred to the south shore, and re-erected together with separate outside staging for the south shore anchor arm trusses The placing of this material was completed by July 9th, when the erection of the main shoes was begun, followed by truss material in the same sequence as described above for the north shore

Profiting by the experience gained on the north shore, very much better time was made in erecting this material a saving of some six weeks being effected The anchor arm trusses, together with the main post and links at the top of the main post, were completely erected by the end of the first week of November, 1915 The inside falsework was then removed and sent back to the shops at Rockfield, P Q, to be remodeled for use in the erection of the suspended span in 1916 at Sillery Cove—about three miles below the bridge site.

The suspended span, 640 ft. long by 88 ft wide weighing in the condition of floating in approximately 5,000 tons, will be erected on falsework and raised on six scows 32 ft. by 160 ft, having a draft, when carrying a load, of about 8 ft. The span will then be floated to the bridge site, where it will be hoisted into position by means of eight 1,000-ton hydraulic jacks, placed in pairs on jacking girders at each cantilever corner, together with plate hoisting links. Each operation of these jacks will lift the span about 2 ft. Altogether, the span will have to be hoisted vertically about 130 ft. The time consumed in this operation is not expected to exceed twenty four hours.

If nothing interferes with the schedule mapped out, it is expected that the south cantilever arm will be completed and ready to receive the suspended span about the end of September, 1916, when, after many years of effort, this great steel bridge—the largest in the world, and the last link in the National Transcontinental Railway System between the Atlantic and Pacific Oceans—will have been finished.

The Problem of Gasoline Supply

(*Concluded from page 466*)

It is said that one concern spends more than $150,000 each year collecting and tabulating statistics relating to the production, distribution and consumption of petroleum and its products in the United States alone If the statistics are of sufficient importance to justify their collection and tabulation by a private concern, does it not indicate a field in which the Government should seek to supply all parties engaged with corresponding information? Such a service would be of interest not only to the industries themselves but also to the country as a whole.

The only hope for the speedy reduction in the high prices of gasoline, according to Van H Manning, the director of the Bureau of Mines, Department of the Interior, lies in the immediate development of the so-called Rittman cracking process and similar processes. He declares that the prevailing prices may not only continue for some time but will undoubtedly reach higher levels before there is any permanent relief. He points to the

that the oil companies, in competition to supply the United States Government for the next fiscal year, have offered gasoline at 21¼ cents a gallon for the whole year, and argues from this that, if the United States, using vast quantities of gasoline, is compelled to pay this much, the private consumer will have to pay much more. Furthermore, Mr. Manning says that with a rate of production the same as in 1915 the crude oil supply of the United States, from which we are getting our present supply of gasoline, will be exhausted in 27 years.

"And what is still more important to the situation, present indications forecast a decreased production of gasoline from crude oil for 1916 rather than an increased production. The daily production of crude oil for February in the Mid-Continent field, which produces 75 per cent of our refinable crude oil, was 40,000 barrels less than the average daily production for 1915, and 20,000 barrels less per day than the average production in 1914, and this is in the face of a strong incentive to find new fields given by the rising market of the past six months, which has culminated in record high prices for that field of $1.55 per barrel for the crude, with, in some cases, a premium exceeding 40 cents per barrel.

"The demand for gasoline has outstripped the demand for all other petroleum products with the result that these other products, amounting to about 75 per cent of the production, are being sold for less than the cost of production. In other words, 25 per cent of the production, consisting chiefly of gasoline, must pay all costs in addition to the amount that is lost in marketing the remaining 75 per cent.

"We are exporting at the present time 20 per cent of our entire production of crude petroleum, including 16 per cent of our gasoline production We are burning 25 per cent of our petroleum under boilers, which is a shameful and criminal waste of precious natural resources, and we are using another 20 per cent of our crude petroleum inefficiently in competition with coal as in the manufacture of artificial gas. Three fourths of the entire amount of artificial gas in this country is made from petroleum. This gas could be made from coal, except that the gas manufacturers are able to make it at less cost from petroleum, owing to the lower cost of oil as against coal It is needless to say that petroleum should not be used for this purpose.

"The solution of the problem is conservation—our petroleum resources being put to their proper uses. Let us stop this wasteful foolishness of burning petroleum under boilers and the use of crude oil in the making of artificial gas. If by means of cracking processes, such as the Rittman process, our kerosene and fuel oils, which we have been using in competition with coal and selling for less than the cost of production, can be converted into gasoline, the present production of crude petroleum would be more than ample to supply our present demands for gasoline Not only that, but the general adoption of these processes would result in extending the life of our petroleum deposits, based on present demands, from 27 years to more than 100 years, at the same time reducing and stabilizing the cost of gasoline to the consumer and preventing the rapid fluctuations in price. Ten different refineries are now installing the Rittman process and more companies are considering doing so. This is but a drop in the bucket, but the situation is hopeful

"The importance of petroleum cannot be measured by dollars and cents. Figures cannot convey an idea of the dependence of many industries upon petroleum products of one kind or another. Lubricating oils, all of which come from petroleum, are absolutely necessary to our very existence. It has been computed that the machinery of the nation requires approximately one gallon of lubricating oil to each 300 horsepower per day, roughly speaking. Every automobile built but adds to the demand for lubricating oil; every ship launched, every [illegible] must be supplied with lubricating [illegible] to the [illegible] of supply. To-day we are burn-

hug this precious lubricating oil under boilers as fuel oil, without adequate financial reward and with utter disregard to the nation's future requirements. One student of the oil situation says that through the wasteful use of petroleum resources the United States is now confronted with a national crisis of the first magnitude, and he may not be far wrong."

Proposed Improvement of New York's Hudson River Front

(*Concluded from page* 467)

The railroad, in addition to paying the cost of eliminating its grade lines, will expend close to $15,000,000 for improvements that are wholly of a municipal character For instance, it will pay the cost of tunneling and covering its tracks along Riverside Park, for covering the main tracks in Manhattanville and in Fort Washington Park, as well as for tunneling and covering tracks at Inwood Hill

The plan appears to be an excellent bargain for the city, and is probably the best solution of a problem that has been particularly vexing for a great many years

Building a Cave at the American Museum of Natural History

(*Concluded from page* 470)

stalagtites in various shapes so colored by the percolating water through the red clay soil. The chamber was 90 feet from the floor of the cave and obviously most difficult of access, requiring the building of an improvised stairway for getting in and out of the grotto. A month or more was consumed in the important and dangerous operations of sawing and breaking off the great array of formations existing in clusters—in some instances huge fluted masses and great pillars reaching from floor to ceiling These in most cases, were tinted a delicate salmon color Two hundred and fifty boxes of material were secured and shipped to New York, besides these, numerous photographs and sketches were made to serve as studies and guides to construction.

Mr Peters, with artistic and technical skill, has succeeded in imparting to the cave reproduction both pictorial beauty and scientific accuracy of detail As an educational feature the grotto is unique this display tells the entire story of the grotto in a few feet of space From the ceiling of the cave hang stalactites from 3 to 4 feet in length, some of which are in the shape of huge clusters of grapes Adjoining the walls are large sheets measuring 6 feet long and 8 feet wide at the top, narrowing down to almost a point at the bottom, which are so transparent that when a light is placed behind them a beautiful striped design, somewhat similar to an Indian blanket, is obtained From the floor rise stalagmites from 1 to 6 ins. in height, some of them joining stalactites hanging from the ceiling, thus forming a solid pillar The side walls contain small grottos or recesses in which hang thin white stalagmites in process of formation Above and below these recesses are curiously shaped formations which somewhat resemble fish and hence have been given the collective name of the "fish market" Adjoining is a column 5 feet high, rising out of a fountain formation. This terminates in a large fluted or fan shaped mass that hangs like a canopy Water will be caused to drip from the joints so as to furnish to the visitors a vivid impression of how stalagmites and stalactites are formed To the left are large sheet formations joining wall and ceiling. Lights have been introduced behind these to bring out their beautiful patterns. The largest and most wonderful specimen of the cave formations is a huge fluted mass resembling in shape an elephant's head. It stands 9 feet high and is almost transparent, although it has many folds and ridges. It weighs in the neighborhood of 1,750 pounds. Electric lights have also been placed in back of it and striking effects produced through its transparent fluted sections.

The entrance to the cave has been so arranged as to allow visitors to enter inside for a distance of about 5 feet; the remaining portion will be inclosed. In

[illegible] The various sections, walls, ceilings, stalagmites and other features have been so deftly [illegible] that the closest scrutiny fails to detect any of the joints. In keeping with the original cave, clay has been used in modeling the floor formation, and this also will be employed on the exterior.

An Ice Mine that Freezes in Summer and Melts in Winter

(Concluded from page 470)

A shelter was erected over the mine some time ago; but it had to be removed, as the ice melted when the sun's rays were kept from the mine.

The mine has been used as a cold storage plant by the wife of the farmer, and she claims that eggs have been kept seven month in the natural refrigerator and at the end of that period found to be in perfect condition. During the summer the temperature of the mine ranges from 25 to 30 deg above zero. This mine, notwithstanding the fact that it is open at the top, is warm enough on the coldest winter's day to keep vegetables without freezing.

The ownership of this natural curiosity has recently changed hands, and now the business men of Coudersport are coöperating with the new owner in an effort to attract more tourists to the place. They are planning an extensive advertising campaign, which will include advertising in automobile guide books Important improvements on the roads, buildings, and the park surrounding the ice mine are to be carried out before the coming summer The contemplated opening of the new road running directly past the mine, the Jersey Shore Turnpike, will make visiting the mine and grounds particularly convenient to autoists in the East.

A Double-Negative Camera Which Reproduces Images in Natural Colors

(Concluded from page 471)

sion the path of only one point of light from the image photographed has been traced from its source as a point to its expansion as the base of a cone in the lens and its reconversion to a point at the surface of the plate. It must be remembered that a countless number of rays are received by the lens in the making of a photograph and that probably millions of rays pass through each of the holes in the perforated mirror to form the images on the two plates.

It should be explained here that all ordinary photographic plates are color blind, as it were, to everything except blue and violet. They are made color sensitive by treating them with rare dyes, such as pinacyanol and pinachrome, in the weakest sort of solution—one part dye to about one million parts of water, for instance The first of these dyes makes the plate sensitive to red and orange light rays, the other, to green and blue.

A green filter, *G*, is interposed in front of the direct plate in the color-photography camera, so as to record the object by green light on that plate, while a red filter, *I*, is interposed in front of the plate that is acted upon by the reflected rays or beams of light. Thus it becomes possible to record simultaneously the same object on the two negatives. The exposure in the studio is from two to eight seconds, while in sunlight it is as fast as a fiftieth of a second.

Owing to their sensitiveness to red light, the plates are developed in total darkness. The plates of course appear in black and white, one represents the red record and the other the green record of the object photographed. Both negatives record exactly the same object and register exactly the same size. The point of variation rests in the fact that the red values of the photographed object are recorded with greater density on the red negative, while the green values are recorded with greater density on the green negative.

From the two negatives two positive prints in black and white are secured by [illegible] in a manner similar to [illegible] [illegible] red, while the positive from the red negative is dyed green. If a little thought is given to the subject it soon becomes apparent why this reversal in the dyeing is necessary.

The new method of coloring the positive plates was discovered by Mr Hoyt Miller through many researches made for this process. By this treatment the black and white positive is converted into a pure dye image and the opaque black silver eliminated in a few seconds' time At the same time the transparent portions of the positives, which form the whites in the final picture, are protected from the slightest discoloration. Plates of great luminosity and brilliancy are secured, with the result that when combined they form a sharp and perfectly colored image without the slightest discoloration in the whites.

The two positive plates, perfectly registered and now cemented together to form the complete picture in the form of a transparency, are ready to be transferred from their glass supports to any other form of support that may be selected This work is accomplished by carefully removing the emulsions from the plates and stripping them onto their final support which may be paper, canvas, porcelain or ivory, the latter in the case of a miniature

Specimens of the work produced with the Brewster camera and process are most faithful in the reproduction of the image, and the hues found in some of the pictures represent a wide range in the color scale despite the fact that only two of the three primary colors are used It is the opinion of the inventor of the process that its use is not limited to the taking of photographs he believes it will eventually find its way into the printing and lithograph trades as a more expedient, less expensive, and a more faithful method of color printing

NEW BOOKS, ETC.

PRACTICAL ELECTRICAL WIRING. By John M Sharp. New York D Appleton and Company, 1916. 12mo, 256 pp.; illustrated. Price, $1 net.

In this manual the student is introduced to the principles and practice of wiring for and installing the required fittings for bells, motors, telephones, and lights. The method of distributing current by different systems is simply explained, there are wiring tables and data that will be of material assistance in actual work, and methods are suggested that may lead to a saving of time and material and an increase in profits. There are also abstracts from the National Electric Code, and through out the work an effort has been made to comply with the rules of this Code.

COLOUR. A Handbook of the Theory of Colour By George H. Hurst, F C S. Second edition, revised by H B Stocks, F I C, F C S London Scott, Greenwood & Son, 1916. New York D Van Nostrand Company 8vo, 160 pp Price, $3 net.

"Colour" is a British manual particularly addressed to artists, painters, dyers, calico printers, and decorative designers. The cause and effects of color, and the results obtained from various mixtures and combinations, are carefully explained, and there are chapters on such subjects as the physiology of light, contrast, and the measurement of color The numerous plates adequately convey the appearance of the absorption spectra of dyes, the effect of mixing colors, color contrasts, and the three-color process of printing Those craftsmen who care to possess more than a merely superficial knowledge of their work will find in this volume much illuminating and interesting exposition, and will be helped to a firmer grasp of those principles that so greatly contribute to artistic and satisfying results

THE PRACTITIONER'S MEDICAL DICTIONARY By George M Gould, A.M, M D Third edition, revised and enlarged by R. J. F Scott, M.A., B.C.L., M D Philadelphia P Blakiston's Son & Co. 1916. 8vo., 962 pp., illustrated. Price, $2.75.

The various Gould dictionaries need no introduction to the profession, and this revised and enlarged edition of "The Practitioner's Medical Dictionary" is worthy of the highest praise. A nice discrimination has been exercised upon the work, resulting in the retention of all the terms in current use, with the addition of many of the words of allied sciences yet the volume has been kept well within a handy size and weight. Derivations are carefully given, and pronunciation, instead of relying upon diacritical marks, is indicated by a phonetic respelling. The definitions are sharp and accurate, and the type clear This edition presents no less than 20,000 new terms, bringing the total number of words up to more than 70,000.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14090) A. A. L. asks Will you kindly tell me through your Notes and Queries column how to fasten the tinfoil pieces to the plates of Wimhurst machines? I have tried shellac and glue without success. The shellac dries around the edges first, and never dries directly under the foil Is tinfoil used on commercial machines, and how is it put on? If not, what is used and how is it put on? Thanking you in advance A. Shellac is commonly used for cementing the tinfoil sectors to the plates of Wimhurst machines. We have machines which were made 20 years ago, and have given no trouble We presume the shellac is dry by this time. You might use a cement which is melted by heat and then hardens when cold Such cements are made *for tire cements* Heat the plate and the tin foil with the cement upon it. It can then be applied without cracking the plate and, when cold the sector will be firmly attached to the glass.

(14091) A E W asks I have seen it stated in books on astronomy that there is a shift of the spectrum lines toward the violet when the earth is approaching a star or the star approaching the earth and that this shift is caused by the *decrease in wave length* For instance, such is stated in Young's "General Astronomy" (ed. 1900), Sec 821 Now, if the earth is at rest and the star approaches it, there will be a decrease in wave length and an increase in wave frequency, but if the star is at rest and the earth approaches it there will be an increase in wave frequency but the wave length will remain constant Now is there a spectrum shift in the second case as well as in the first? If so it would seem to me to be purely a question of wave frequency and not of wave length at all A The Doppler Fizeau principle is stated as follows When the distance between an observer and a body which is emitting vibrations is increasing, then the number of vibrations received in a second is decreased, and their wave length real or virtual is correspondingly increased, and *vice versa*, if the distance is decreasing It matters not whether the star is approaching us, or we, the star, or both be in motion only the change in the distance which separates us from the star is concerned in the result Then too the velocity of light is not changed, and there must be a change both in the number of vibrations per second and in the wave length One of these cannot change without producing a change in the other, and in an inverse order An increase in the number of vibrations must produce a decrease in the wave length If the wave length is decreased the spectrum lines must be moved toward the violet and an increase in the wave length must move the lines toward the red This has now been so carefully worked out that a change of distance of less than a half mile a second can be detected This matter is treated much more fully in Young's "Manual of Astronomy," than in his earlier book the 'General Astronomy' We send the 'Manual' for $2.50 postpaid.

(14092) C P asks Kindly send to me any information dealing with the subject of electro plating and liquid chlorine. A. At 141 deg Cent. chlorine gas is liquefied by a pressure of 83 9 atmospheres. Above that temperature it cannot be liquefied. At ordinary temperatures 18 deg Cent. it is liquefied by 16 5 atmospheres. In the cylinders in which it is shipped the pressure is much greater than this, and the chlorine must be in a liquid state The liquid chlorine is sold and shipped in tubes to any part of the country Copper plating is fully covered in "Modern Electroplating" by Van Horne, which we send for $1 00, and shall be pleased to fill your order for the book. This book gives the full directions for preparing the work for the plating and finishing of the article.

(14093) H F W asks 1 We use your magazine for supplementary work in high school physics. The latest article I have found on the Edison storage battery is in the January 14th, 1911, number Does that article correctly describe the last Edison storage cell? 2 Have you recently published an article in which the distinct vision of birds, such as eagles, is explained by assuming that they have eyes which are not sensitive to short waves of light? If so, will you refer me to the article? 3 The chief forecaster of the Weather Bureau here stated that the forecasts concerning time and height of tides, and the exact position of the moon in the sky at a given future time, are as uncertain as the weather forecasts. Is it true that astronomers do not know where the moon will be at any future day? 4. Our local paper states that the bright star south of Orion, about 5 feet from the horizon, is Canopus. If we cannot see it every year, why can we see it now? A. 1 There has not been any considerable change in the

Edison storage cell for quite a time We have not had any article on this cell recently An article appeared in the SUPPLEMENT, No. 1879, on the manufacture and performance of this battery, which is later than the date you name. This will doubtless interest you. The paper can be had from the Wilson Company. 2. We do not recall any article, such as you describe, on the vision of high flying birds. 3. The opinion which you quote that astronomers cannot foretell the tides and the position of the moon at a future time any better than forecasters can foretell the weather is far from fact. The eclipses of the sun and the moon, both of which are calculated from the position of the moon at that future time are calculated for centuries ahead. The tides are calculated by a machine for any port in the world with wonderful exactness. This machine is in the Coast and Geodetic Survey, Washington, D C It is described in the SCIENTIFIC AMERICAN, Vol 110 No 10 where it is called a Great Brass Brain and it deserves that name It can predict the tide, its height and time, taking into account as many as 85 components which influence its height, its rise and fall, and its time It is stated in that article that a tide was predicted for Aden, employing 35 components and that the error was only 02 feet. This is surely nearer than the Weather Forecaster can come in predicting a storm a year before the time 4 The bright star about which you inquire is Canopus, but it is not 6° above your southern horizon The declination of Canopus is —52° 39' The latitude of your place is a little above 34°, so that the elevation of the Equator is about 56° with you, and the declination of Canopus taken from 56°, leaves about 3° 30 as its elevation above the horizon To this must be added the refraction which makes its apparent altitude a little more than 4° A degree at the horizon is distorted or magnified, just as the sun and the moon are at their setting by an optical illusion People rarely think of this. Stars appear farther above the horizon or farther apart than they would be judged if they were high in the heavens. This star should be seen on clear nights every year in February at your place

(14094) M J asks What is the relative frequency of letters and numerals in the English language? A In cryptography the relative frequency of letters in the English language is taken as follows

A	B	C	D	E	F	G	H	I	J	K
20	4	8	11	33	6	5	16	17	1¼	2

L	M	N	O	P	Q	R	S	T
10	8	19	21	6	¼	18	17	23

U	V	W	X	Y	Z
8	3	5	1	5	—

The frequency of numerals is not subject to the same laws governing the frequency of letters.

(14095) C A. S asks 1 Is there any formula for figuring forces exerted in a cam action such as is applied in a punching machine from the moment the pressure is exerted to the completion of the action? 2 Why does a drill become magnetic when drilling steel or cast iron? A The cam is a revolving inclined plane The pressure exerted by a punching machine is calculated as it is in the inclined plane and the screw The force applied multiplied by the distance which it moves and divided by the distance the punch moves gives the total pressure. If the shape of the cam is such that the punch moves more slowly at one time than at another you must find the distance the force and the cam move during the same time at each part of the stroke Steel is magnetized by the action of the earth upon it A steel wire suddenly bent will be slightly magnetized A steel bar given a sudden shock, for example a blow when it is held nearly vertical, will be magnetized All iron or steel standing vertical or nearly so becomes magnetized by the earth's magnetism The stress and jarring of the drill magnetizes it.

(14096) E. J R asks A discussion has arisen between myself and friends, viz My opponents contend that gasoline and kerosene can be ignited by a lighted cigar cigarette or lighted pipe I content that this cannot be done We have decided to let you be the judge to say which is right A It would not be difficult to determine the answer to your question for yourself by experiment Try it and find out whether a cigar will ignite gasoline vapor and if you find it will not then try and see if it will ignite the gasoline itself. Do the same with kerosene oil A small quantity in a saucer will be sufficient for the test You will find that a cigar will not ignite gasoline vapor, and that the cigar will be quenched in gasoline and extinguished as completely as it would be in water, without setting the gasoline on fire Good kerosene oil will extinguish a lighted match in the same way

(14097) W S B asks I wish to ask a bit of information. Last August a year a lot of mirrors were mounted in a new concrete building, yet damp. Later the mirrors became streaked, whitish, and now they are being stripped with nitric acid and are found to be pitted and shows more plainly after being polished with rouge. The chemicals used in making the mirrors are nitrate silver wet with ammonia, precipitated with tartaric acid to the plate after it has been washed with a weak solution of "Tin Muriate," C P., afterwards covered with a coat of shellac, on which is put a coat of mirror paint. Now what caused the streaks? Could it be that the fumes from the

time in the cement would form hydrofluoric acid and have an effect with the tin and pit the glass? A. We cannot pronounce positively as to the reason for the pitting of the glass of your mirrors. It was probably due to the wet walls against which they were hung. Just what the chemical action was we would not care to attempt to say If the walls are now dry, it is probable that the action will not occur again. It might be advisable to place something between the mirror and the wall which would act to keep moisture from the wall away from the mirror. A piece of oil or rubber cloth tacked over the back of the mirror would do this.

(14098) C. H B. asks I address you for the purpose of finding out, if possible, something relative to the nature of water that never freezes, and seemingly never varies in any season There is a small stream running through this section for many years, clear as crystal, palatable, etc The water is quite cool in the summer period, and it never freezes, recently it was 30 deg. below zero, and not the least indication of freezing I might add, it flows steadily all the time through a wooded hilly section A Springs from sources so deep that they do not freeze will flow winter and summer The water is cooler than the air in summer and warmer in winter There are many such springs throughout the country There would not seem to be any peculiarity in the water If it contained minerals in solution the minerals would crystallise out and would be recognised Usually such spring water is very clear and sparkling

(14099) S. A. D asks 1 Will you please inform me through your Notes and Queries column, where I may obtain the best and most up-to-date book or article on the design and manufacture of Storage Batteries? I would like to know particularly the weight of active material per ampere hour of capacity, the weight of grids per ampere hour, weight of necessary electrolyte per ampere hour, and the total cost per ampere hour for the best type of lead plate battery and, for comparison the same data for the Edison Battery 2 Also, I would like to secure through your inquiry column the name and address of a manufacturer of glass cloth, or woven glass fibers. 3 May I call your attention to some errors which I have noticed recently in your answers? Referring first to No 14050 in the issue of Feb 10th, 1916 in reply to P M C asking for a method of calculating the weight per cubic foot of oxygen at 72 deg Fahr It seems to me that your answer is in error in two respects First you state that the expansion for each degree is 1/459 of the volume at the freezing point and that when heated to 72 deg it will 40/459 of the volume at 32 deg Now the absolute Fahrenheit temperature of the freezing point is not 459 but 491 and therefore the expansion per degree will be 1/491 of the volume at the freezing point and when heated to 72 deg it will expand 40/491 of the volume of 32 deg Second you state that there will remain in the original cubic foot of space 419/459 of the weight of gas originally in the space Applying the correction just noted, this would be 451/491 That this is not correct can easily be seen by considering a somewhat simpler case Assume a certain weight of gas occupying 3 cu. ft. of space let it be heated until the expansion is 1/3 of the original volume the new volume is then 4 cubic feet, and it is evident that the original 3 cubic feet will contain, not 2/3, but 3/4 of the total weight. That is, the original volume becomes the numerator and the expanded volume the *denominator of the fraction* expressing the proportional density whereas your solution takes the original volume as the denominator, and the original volume minus the expansion as the numerator The correct proportion is therefore, 491/531 of the original weight per cubic foot. Of course the simplest solution is to apply directly the law that the density of a gas is directly proportional to the pressure and inversely proportional to the Absolute Temperature. In this case, since the pressure is assumed to remain normal, the formula is $D_{72} = D_{32} \times 459 + 32 / 459 + 72 = 0.0892 \times 491/581 = 0.0824$ lbs per cubic foot. 4 Referring next to query No 14008 in the issue for January 1st, 1916 second part The question is, What would be the result if a gun capable of shooting a bullet at the rate of 60 miles per hour is fired from the front end of a train moving at the rate of 60 miles per hour at a man on the rear end of the same train? Your answer is that the man at whom the bullet was fired would be killed if the aim was good This seems to me to be in error in two respects. In the first place, the bullet would not strike the man for the following reason *As correctly stated in your answer* to the first part of the query a bullet fired under these circumstances would have no velocity relative to the surface of the earth, and, on account of the action of gravity, would begin to drop toward the ground. Now, if the train is of moderate length, say, 440 feet, it would require just 5 seconds for the man on the rear to arrive at the place where the bullet was fired. In this interval the bullet would have time to fall under the acceleration of gravity a distance of 400 feet, if not obstructed In the second place, if by some means the action of gravity could be prevented, the bullet would remain suspended in space at the place where it left the gun and the man, on account of the motion of the train, would rush forward and strike it. But the result would hardly be disastrous, as the velocity of impact would be only 88 feet per second (equal

to the velocity of the train), or approximately 1/20 of the ordinary velocity of a rifle bullet. While 60 miles per hour is a fairly high velocity for a train, it is a very slow speed for a bullet In thanking you for your attention to the above requests, I would like to express my appreciation of the SCIENTIFIC AMERICAN One of its most valuable and interesting departments is the Notes and Queries column. A The standard book on the storage battery is Lyndon's Storage Battery Engineering, price $4.00, which seems to cover the subject very fully We regret that we do not know any maker of glass cloth We have a sample which we have kept for many years to exhibit in lectures, but have not seen any other piece for years. Referring to the error in stating the number of degrees from absolute zero to the freezing point of water the centigrade zero—we had discovered and started the correction before your letter was received Such typographical errors sometimes occur unaccountably We thank you for your interest in the matter As to your criticism of the note about firing the gun at the man on the rear of the train, it was not stated either in the query or in the answer that the gun was to be fired horizontally as you assume in your criticism The gun would be elevated properly of course or gravity would not be considered In either case the bullet would hit the man Then too what you say of the low velocity of the bullet is true It is a low velocity but for all that we would not care to be hit with a small caliber, pointed bullet going 88 feet a second

(14100) *H J Ellis asks* I should like information concerning the lead aluminum rectifier or some other electrolytic rectifier especially as to the peculiar quality of aluminum which permits a current to pass in only one direction and the salt used as an electrolytic, also the chemical action A You will find in the SCIENTIFIC AMERICAN SUPPLEMENT Nos. 1644 and 1767 articles upon the theory and construction of an electrolytic rectifier using lead and aluminum plates and ammonium phosphate as the electrolyte These papers can be had from the Wilson Company The action is due to the formation of a film of oxide upon the aluminum plate which prevents the flow of current from the aluminum plate to the lead plate When the current flows from the lead to the aluminum oxygen is carried to the aluminum plate and the oxygen combines with the aluminum forming aluminum oxide When the alternations are reversed the film of oxide prevents the flow of current, and thus only those alternations from the lead plate can pass. The result is a pulsating direct current The apparatus cannot be employed for large currents

(14101) R. M W asks May I trouble you to answer a question to settle an argument? If the sun should be suddenly demolished, could we under any circumstances get heat enough to keep us alive? With the modern heating plants do you think great enough heat could be obtained from coal oil or electricity? A The heat sent out by the sun is enormous On every 5 feet square in the Torrid Zone the heat is equivalent to 1 horse power while the sun shines To put it in another way upon the deck of a steamer in tropical seas enough heat falls to drive the vessel at about 10 knots an hour if only it could be utilized under the boilers. We do not think man could produce enough artificial heat to replace this amount if the sun should be destroyed The figures we gave above are from Todd's New Astronomy which we send for $1.45 postpaid Abbott's The Sun is also a very valuable and recent work We send it for $2.50

(14102) C W B asks Light and heat both come from the sun apparently traveling together as if one and the same product (1) What is the difference between light rays and heat rays of the sun? A few miles above the earth the temperature is zero constantly, and I assume that temperature continues to grow lower as the distance from the earth increases until absolute zero 459 deg below Fahrenheit is reached (2) Now, in going so many million miles through this intensely cold temperature why is not the heat of the sun completely absorbed or destroyed before it reaches the earth? A. The radiation from the sun is not absorbed in external space, because there is nothing there to absorb it. When it enters the air of the earth or strikes another planet in space then absorption begins. The atmosphere absorbs about four tenths of the sun's radiation. This is no different from radiation on the earth The heat from a red hot ball does not heat the air very much not so much as it would your hand held at the same distance at one side of the ball This is a characteristic of radiation that it does not heat the intervening medium See Carhart's College Physics, page 392 The only difference between light and heat is one of wave length The short waves affect the retina, the long waves affect us as heat.

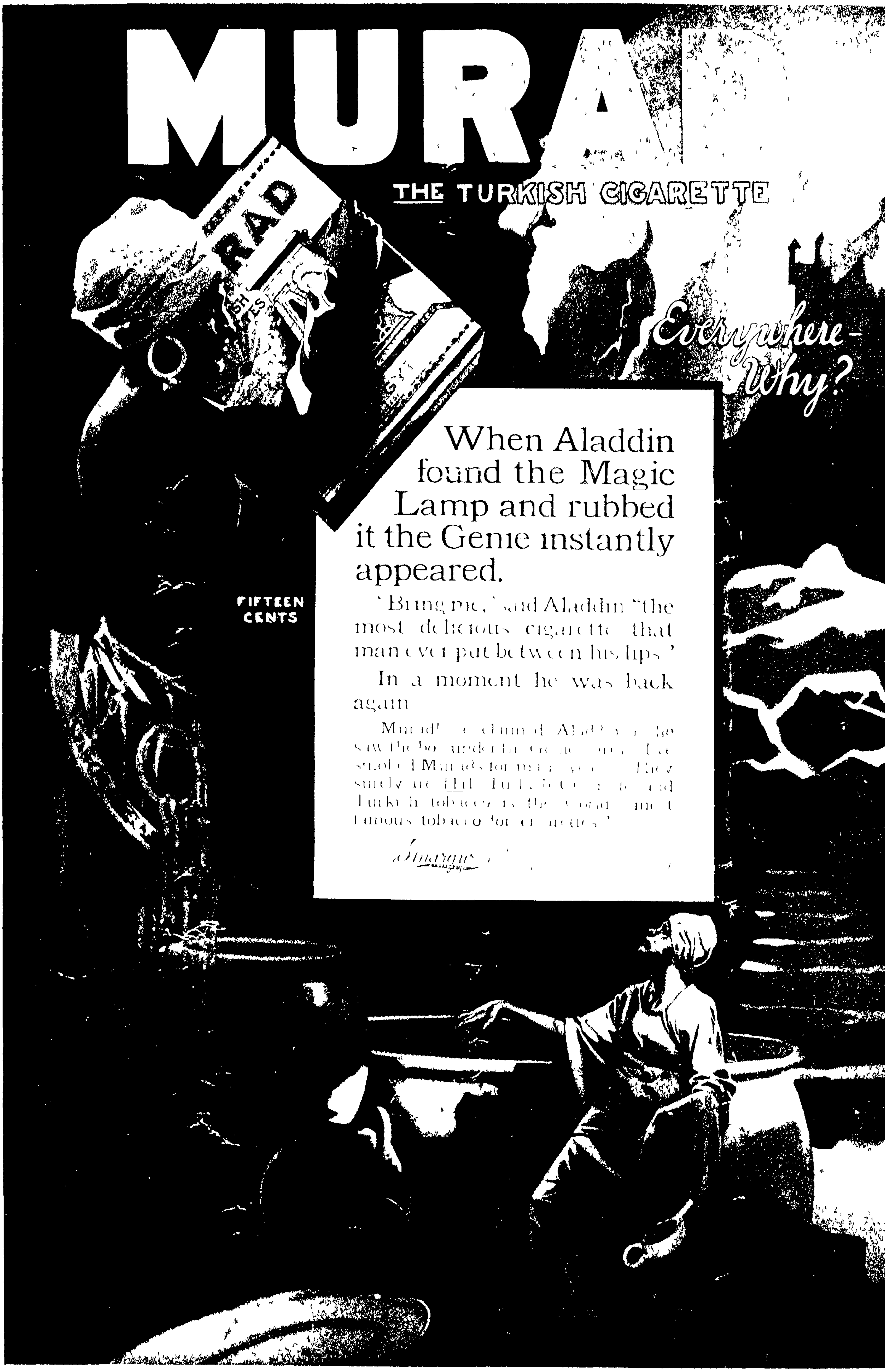
(14103) J W S. asks For the benefit of one of our teachers, will you kindly explain why the Mississippi apparently flows upward from its source to its mouth? If you can, cite me to an explanation, will you do so? If you have answered the question in Notes and Queries, send me a copy of the best answer, and I will be glad to forward price. I used to save my files, but in recent years I have given my copies away after I had used them. A. The question of the flow of the Mississippi River may be answered by

saying that the sea is level. The Mississippi River at its mouth in the Gulf of Mexico is at sea level, while at Minneapolis it is about 790 feet above sea level. This gives the facts in the case. Now, upon what is the statement based which is made so often that this river and all rivers which flow toward the Equator flow up-hill? It is based upon the fact that the surface of the earth is farther from the center of the earth at the Equator than it is farther from the Equator This bulging at the Equator and flattening at the Poles is caused by centrifugal force when the earth was plastic, and the same force keeps both the solid earth and the water in their present positions This water surface is a level surface Water will not run along it. If the land is elevated above this surface, water will run down to this surface and no further The Mississippi River is above this surface along its whole course to the sea and runs down hill all the way

(14104) H D T asks 1 If a flying machine moving at its maximum speed and at a distance of a mile or more from the earth s surface drops a bomb will the bomb fall straight down to the earth, or will it keep the momentum of the machine and drop on a slant? Why? 2 If the same machine is a mile high and stationary and drops a bomb will the bomb strike a point which is directly under the machine when the bomb is dropped? Why? 3 Does the revolution of the earth during the time taken by the bomb to drop a mile change the relative position of the bomb and earth or in other words, does the atmosphere through which the bomb falls travel with the earth in its revolution or is the atmosphere stationary? A A bomb dropped from a flying machine retains the forward motion of the machine while it is drawn down to the earth by gravity Excepting for the resistance of the air it would travel forward as fast as the machine and land on the earth below directly under the place to which the machine has come if the machine has maintained a straight course after dropping the bomb This is in accordance with Newton s First Law of Motion — Everybody in motion continues in uniform motion in a straight line unless compelled to change by some outside force When the bomb leaves the machine it has the same forward motion as the machine and it keeps that motion till it strikes the earth which compels it to change its motion 2 A bomb dropped from a flying machine which is at rest a mile high will strike the earth several feet to the east of the point directly under where it was dropped All bodies dropped on the earth fall to the east All shots fired deviate to the right of the direction in which they are fired If fired to the north they deviate to the east If to the south they deviate to the west This is well understood by gunners and carefully allowed for The cause of all these deviations is found in the rotation of the earth upon its axis A bomb falling goes from a place where the earth is rotating faster to a place where it is rotating slower and it retains the eastward velocity of the place from which it was dropped It therefore moves to the east, and strikes the earth to the east of the point from which it was dropped In the SCIENTIFIC AMERICAN Vol 112, No 21, page 482 you will find an article in which it is stated that a shell fired to the north 12 4 miles will deviate to the east 625 feet This is quite enough to have it miss a large target unless proper allowance is made We can send the paper for ten cents. 3 If the atmosphere moves while the bomb is falling it will carry the bomb with it, and alter the results we have given above Above we considered only the results of the earth s rotation and gravity The air moves with the earth excepting for winds It is not stationary with the earth moving through it Were this the case we should have a hurricane all the time which would strip the earth of everything on its surface excepting the solid rocks.

(14105) W & R asks Some few years ago when I was a regular subscriber to the SCIENTIFIC AMERICAN there was a fluid blue print formula that we would like to have Can you help us to it? Will remit the price upon receipt of advice A For a liquid blue print process, for solution No 1 take of citrate of iron and ammonium 80 grains to each ounce of water for solution No 2, take of ferricyanide of potassium 40 grains to each ounce of water Keep these in separate bottles till they are to be used Then take equal parts of both solutions, and mix, after which the mixture must be kept in a dark room It is better not to mix the solutions long before using and to mix no more than is needed at one time The quantity depends upon the amount of paper which is to be sensitized at one time

(14106) S S. asks Kindly let me know where the day begins and in what part of the globe? A. Theoretically, the day begins at the 180th meridian, but practically the date line is an irregular line drawn so as to include the islands on either side of this meridian in the country near them to which they belong. Thus the date line slants to the west near Behring's Strait so as to take in on its eastern side the Aleutian Islands, which belong to the United States. Further south it bears to the west again to include on its eastern side the Hawaiian Islands, which belong to the United States, and which lie to the west of the meridian. Other detours are made to give islands to the south the same day as Australia.



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May 13 1916

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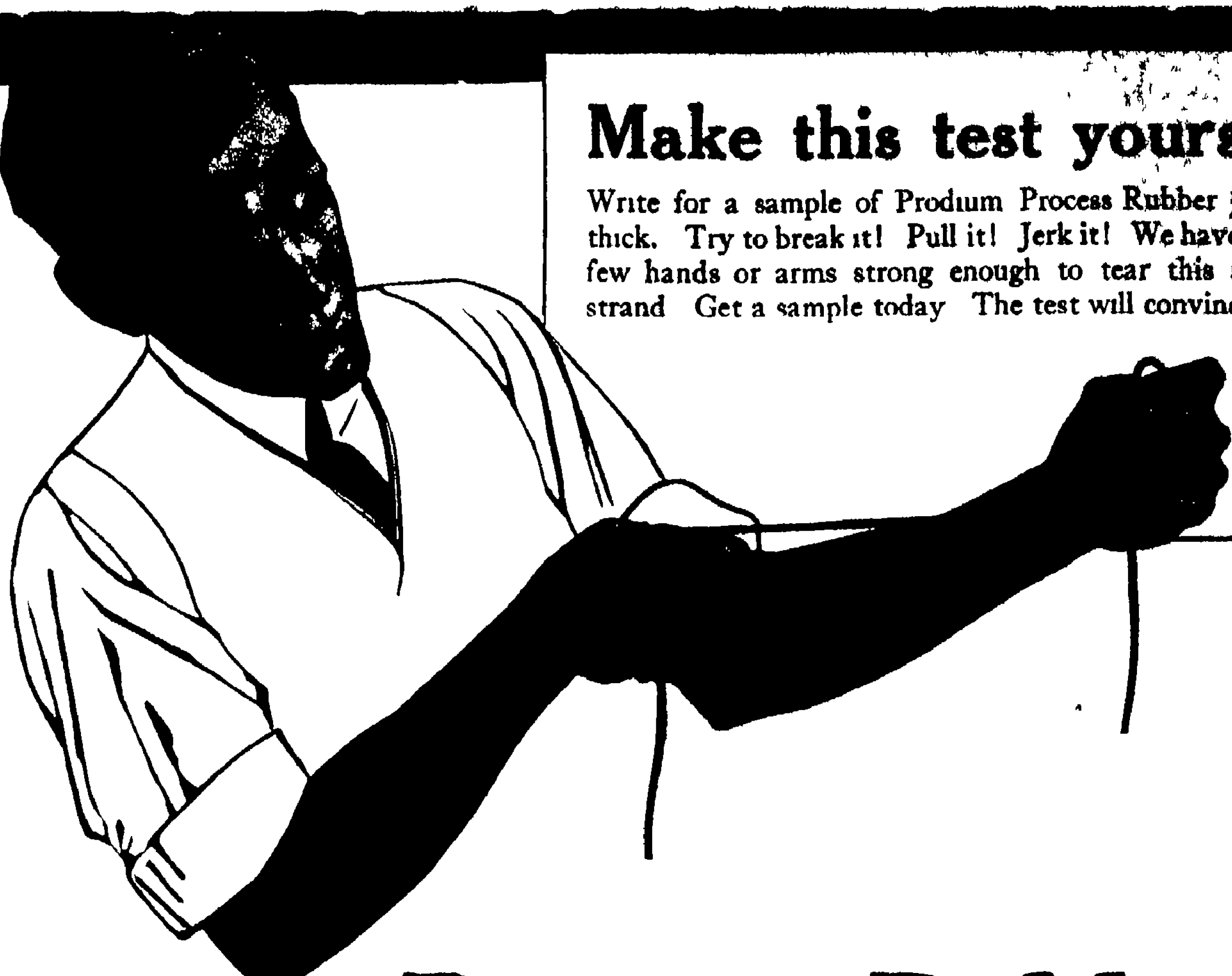

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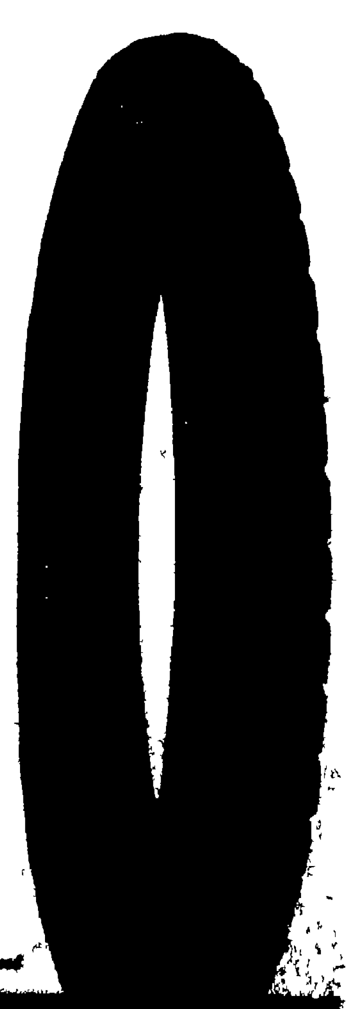

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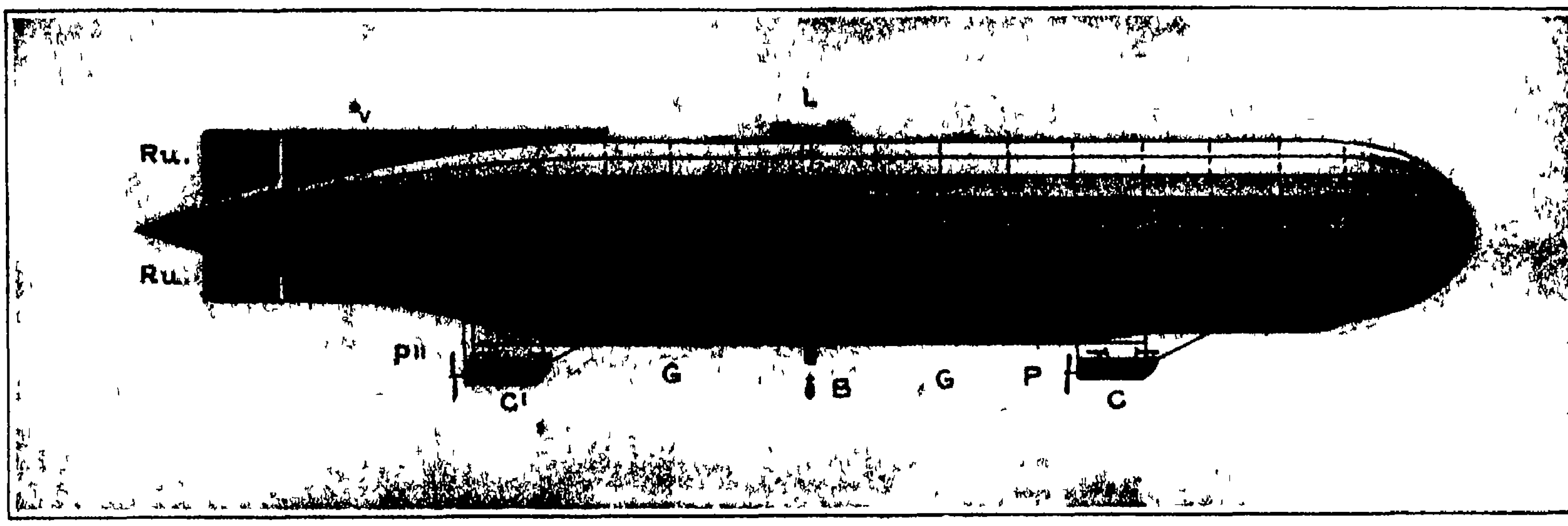

Outline (side-view) of a 30-ton super-Zeppelin Drawn to data obtained from the wrecks of LZ-77 and L-15

(C C') engine cars (the one in front containing the pilot house) (P P'P") propellers (G) gangway connecting the cars and containing water ballast and fuel tanks (St) stairway leading from bomb-room (B) to armed lookout (L), (S) stabilizing fin (E) elevator (V) vertical fin (Ru) rudders

Super-Zeppelins

By Baron Ladislas d'Orcy, Member, American Institute of Aeronautic Engineers

It is common knowledge that for some time past a new type of Zeppelin, far more powerful than any of its predecessors, has been commissioned with the Air Service of the German Navy The recent destruction, by the agency of the Allies anti aircraft artillery, of two of these vessels has now afforded the long sought opportunity for getting a closer view of this type of aircraft, which for the sake of convenience we shall term a super Zeppelin

A layman might hardly discern any change in the outward appearance of a super Zeppelin when compared with previous types, it appears, however, upon examination of what remained of the vessels destroyed at Révigny (the LZ-77) and in the mouth of the Thames (the L-15), that the hull, steering organs and propelling apparatus have been re-designed to a great extent on the latest types.

It is a matter of discussion whether there exists but one new type or whether the Zeppelin Works still turn out a large, long range type for naval raids and one, smaller but faster, for military reconnaissances. The fact remains, however that the Germans possess at present a large type of Zeppelin whose features, as far as they are known, shall be discussed herewith

THE HULL.—The hull of the *ante-bellum* Zeppelins was in the shape of a cylinder with two symmetric ogival ends —a very poor form, aerodynamically speaking, and it was still made worse by an exaggerated aspect ratio of ten to one, which comes to say that the hull was ten diameters long

On the super-Zeppelin this defect has been remedied to some extent. The bow is slightly blunter than before, while the stern is nearly conical, furthermore, the aspect ratio has been somewhat decreased, so that now the hull is only about eight or nine diameters long Although this ratio is still some way off the one disclosed by aerodynamic research work to effect the smoothest air flow (6:1), it must materially assist the super Zeppelin in attaining a greater speed without the expenditure of additional power

Regarding the size of super-Zeppelins, an examination of the wreck of the LZ-77 reveals that this vessel (which undoubtedly belonged to a recent type, as is disclosed by her factory number) was about 540 feet long, with a displacement of over 1 100,000 cubic feet which would furnish a lift of about 33 tons

THE STEERING ORGANS.—The steering organs have been greatly simplified on the super Zeppelin

A picture of the L 15 (which was photographed before she broke up and sank) shows clearly that in place of a large number of small and parallel rudders and elevators there is now a compact *empennage*, very similar to that of a tractor aeroplane Both rudder and elevator now consist of simple "flaps" which are hinged to the vertical and horizontal fins respectively

Table Showing Probable Zeppelin Losses from August 1st, 1914 to May 3rd, 1916

No	Name	Place.	Date.	Cause of Loss
1	Z-8*	Badonvillers France	22- 8-1914	Destroyed by French gunners. Part of crew lost.
2	Z-5*	Mlava Russia	29- 8-1914	Destroyed by Russian gunners. Crew lost
3	?*	Sorada Russia	6- 9-1914	Captured while at anchor by a cavalry patrol Crew of 30, prisoners.
4	?	Düsseldorf Germany	9-10-1914	Destroyed in shed by British aviators.
5	LZ-31*	Friedrichshafen Germany	21-11-1914	Destroyed in shed by British aviators
6	?	North Sea	23- 1-1915	Foundered during a storm
7	L-3*	Esbjerg Denmark	17- 2-1915	Stranded having run out of fuel and broke up Crew of 16 interned
8	L-9*	Boulogne France	5- 3-1915	Foundered during a storm after having raided Calais Crew lost.
9	L-8*	Tirlemont Belgium	4- 3-1915	Damaged by British aviator wrecked on landing 21 of crew killed
10	?	Thielt, Belgium	13- 4-1915	Damaged over Béthune by French gunners wrecked on landing
11	?*	North Sea	26- 5-1915	Broke away without crew foundered off Heligoland
12	LZ-37*	Evere Belgium	7- 6-1915	Destroyed in shed by British aviators
13	LZ-38*	Ghent Belgium	7- 6-1915	Destroyed in mid air by British aviator crew lost
14	L-7*	Ostend Belgium	10- 8-1915	Raided London Destroyed upon her return by British aviators.
15	?*	Vilna, Russia	24- 8-1915	Shot down by Russian gunners crew of 10 made prisoners
16	?*	Saint-Hubert Belgium	13-10-1915	Destroyed by exploding in mid-air
17	?	Maubeuge France	16-10-1915	Stranded on a chimney and broke up.
18	?	Grodno Russia	5-11-1915	Destroyed by the storm on landing
19	L-18*	Tondern, Germany	17-11-1915	Wrecked in shed through an accidental (?) explosion
20	Z-28	Hamburg Germany	17-11-1915	Wrecked by the storm
21	L-22*	Tondern Germany	1-12-1915	Destroyed in shed through accidental explosion of a bomb
22	?*	Kalkun Russia	5-12-1915	Shot down by Russian gunners. Crew lost
23	?*	Mainvault Belgium	30- 1-1916	Raided Paris Damaged by French aviator wrecked on landing
24	L-19*	North Sea	21- 2-1916	Raided England Probably run out of fuel, foundered Crew lost.
25	LZ-77*	Révigny France	21- 2-1916	Shot down by French motor guns destroyed in fall Crew of 15 killed
26	L-15*	Kentish Knock England	1- 4-1916	Shot down by British gunners, crew of 18 surrendered Vessel sank
27	L-20*	Stavangor, Norway	3- 5-1916	Raided Scotland. Stranded having run out of fuel and drifted with the wind Blown up by crew 3 killed 16 interned

* Destruction authenticated.

Their surface area has naturally increased as the conical stern takes up less space than when it was blunt, as a consequence and owing also to a smoother air flow, the efficiency of the steering organs should have materially increased

THE PROPELLING APPARATUS.—The distribution of power has been very radically re-designed on the super Zeppelin, the new system being one that follows marine practice closer than was customary hitherto

While the 1914-15 type of naval Zeppelin was propelled by two sets of two 200-horse-power engines, each set driving two air-screws mounted on outriggers on either side of the hull the super Zeppelin carries but one engine in the front car and three engines in the rear car Two of the stern engines drive side propellers in the old fashion, but the third one as well as the front engine each drive a directly coupled propeller at the rear of the cars

The advantages derived from mounting the propellers astern are manifold Firstly, as there is nothing to interfere with the air thrown back by the propellers, the efficiency of the latter should be somewhat increased, secondly, the danger of sparks from the exhaust which might ignite the hydrogen, is rendered very remote and thirdly, the mounting of the engines in the stern car should afford more room in the front car for the navigating *personnel*

One might therefore assume that ultimately the stern car will become the sole engine room, while the bow car will be the navigating room and nothing else If this has not yet been done it should rather be attributed to a lack of higher powered engines than to some obscure reason for keeping one propeller ahead

ARMAMENT.—The armament of these vessels has hardly changed The bomb-room has remained in the middle of the gangway but the crude way of dropping bombs by hand has been superseded by a scientific appliance, whereby the bombs are released electrically

In addition to the two machine guns mounted on each car, two more have been provided for arming the lookout post atop of the hull which is connected with the bomb room by means of a stairway encased in a chimney

* * * * * * *

Thus far the apparent changes affecting super Zeppelins

Modifications relative to the ratio of dead weight to useful load are more or less a matter of speculation On the *ante bellum* Zeppelins the useful load amounted to about one fourth of the total lift According to a statement emanating from Count Zeppelin's secretary, the climbing power of the new type is two fifths better than on previous types and the load of ammunition amounts to two tons It might therefore be assumed that the useful load is also at least two fifths better than heretofore in which case its ratio would be 35 per cent of the total lift

Such an improvement is entirely within the present day possibilities if one bears in mind that the ratio of dead weight to useful load *decreases* with the Zeppelin's size and that the super Zeppelins displace about

(Concluded on page 514)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns especially when such articles are accompanied by photographs

An Inverted Pyramid

BECAUSE of our geographical position, it may be said that the international policies of the United States are founded necessarily upon our navy, and that our policies and our navy are builded—or should be builded—as one structure, pyramidal in form, with the navy as the broad and unassailable foundation We have constructed the pyramid,—there can be no doubt about that but we have inverted it so that, to-day we have an accumulation of far reaching international policies imposed upon a navy all too small to take care of them The joint structure has grown at the top and shrunk at the base so that to-day it is in unstable equilibrium

A distinguished officer of our navy writing not long since on the subject of the policies of nations, had this to say "Modern science has made the nations of the earth neighbors and modern thought has tempered their intercourse But national ambitions take life and grow as the nations prosper, and being like those of the individual essentially selfish the ambitions of one nation *often excite the rivalry and opposition of another So* are born the policies of various people When declared, these policies are but the formulated principles of conduct which the people of a state or their government, have adopted in the pursuit of their national well being When the policies of a state reach beyond its borders, they become of special interest to other states for in these policies may be found the seeds of disagreement, perhaps of ultimate war"

During the first century of our existence as an independent state, we were so much concerned with our domestic affairs that we took but a languid interest in great world policies, and (always excepting the Monroe Doctrine) we had no definitely-enunciated foreign policies which were likely to lead us into conflict with other states The loss of the battleship "Maine" and our subsequent pacification of Cuba however, brought about our long-deferred but inevitable graduation into the first rank of the world powers It was only a few among us who realized what that purely humanitarian effort might lead to As a matter of fact the firing of the first gun of the war shook the country roughly out of its century long international isolation and carried us so far beyond our borders, that at the conclusion of the war our frontier had been moved a thousand miles eastward into the Atlantic and five thousand miles westward across the Pacific even to the very gates of Asia

The significance of the Spanish War however lay not so much in its naval and military successes, as in its appeal to the dormant internationalism (if we may use the term) of the great republic of the New World Among the lessons taught by the war, and fully appreciated by the people and its Congress was the supreme *importance of sea power* When Dewey crumpled up the Spanish fleet at Manila and Sampson and Schley strewed the southern coast of Cuba with the burning wreckage of Cevera's squadron, the decisive influence of sea power always recognized by the naval expert, became self-evident, even to the man on the street. Congress lent a willing ear to its naval advisers and systematically and most liberally built up a navy that should be equal to the heavy responsibilities entailed by our newly acquired and widely separated possessions Within half a dozen years of the conclusion of peace our navy had risen to the position of second in strength, with a commanding lead over that of Germany

But as it so turned out in the very year 1905 which found our navy in a position of such importance the advent of the dreadnought relegated all existing battleships to the second line, and the leading naval powers began to reconstruct their navies along dreadnought lines increasing their annual appropriations greatly in order to meet the crisis which had arisen Our own Congress, unfortunately so far from increasing appropriations, decreased them, and for the past eleven years we have so greatly neglected our navy that it has sunk to the third position in ships and to the fourth position in the number of officers and men From the Spanish war to the advent of the dreadnought, Congress appropriated for the construction of new armored vessels at the average rate of four ships per year, but during the eleven years covering the dreadnought era Congress has authorized the construction of armored ships at the low average rate of only one and one half vessels per year

We see, then that so far as the navy, upon which the United States must primarily depend for the support and enforcement of its international policies is concerned, we have been steadily losing ground relatively to the other great powers This is bad enough in itself but it appears infinitely worse when we realize that during this period of relative decline of our navy among the great navies of the world, we have been emphasizing, adding to and enlarging our international policies on a scale and at a rate which is surely without parallel in the history of the world Thus, we have reaffirmed the Monroe Doctrine by definite congressional action, in which we forbid the acquisition by any foreign power of a port or harbor which might be used as a naval base for operations directed against the Panama Canal We have built the Panama Canal, thereby turning topsyturvy the long established equilibrium of the world's seagoing commerce We have proclaimed the neutrality of the canal, and we have shown our determination to uphold that neutrality by constructing first class fortifications at each approach. We have taken our stand in support of the "open door" in China as opposed to the principle of separate spheres of influence, formerly advocated (and quite possibly to be advocated again) by the European powers And, finally, we have offended the most refined and successful of the Oriental races by telling them that we do not want and will not have its people in any numbers in our midst. Moreover at the present hour we are demanding of the second greatest naval power in the world that it shall practically abandon the use of the only element of its naval equipment with which in its hour of dire extremity it is able to strike back at a victorious enemy

We have said enough surely, to bring home the conviction that the naval political situation in the United States is one which should cause the deepest concern and call for immediate and drastic readjustment Indeed we can conceive of no duty among the many laid upon the present Congress that compares in urgency and in the high authority of its demand with that of restoring our navy with all possible dispatch to the position of second in strength which it occupied a decade ago Here is a question which should be lifted out of the mire of politics and placed upon a high plane of the purest patriotism

Our National Advisory Committee for Aeronautics

AN account of the new United States National Advisory Committee for Aeronautics was published in our issue of February 5th 1916, page 140 The first annual report of this committee has now appeared, and deserves notice as a substantial proof of the fact that this country is taking its place with Germany, France and Great Britain as a leading contributor to the scientific side of an art the practical side of which was already so largely a product of American ingenuity

The greater part of the bulky document in question is made up of a series of reports on particular topics, emanating from both official and unofficial sources. It is especially noteworthy, as a proof of the rising importance of industrial research, that three of these reports are contributed by manufacturing concerns. One on aviation wires and cables their fastenings and connections, comes from the John A. Roebling's Sons Co, Trenton, N J, one on the relative worth of improvements on fabrics from the Goodyear Tire and Rubber Co, and one on balloon and aeroplane fabrics from the United States Rubber Co The Massachusetts Institute of Technology furnishes a report, by Messrs. Hunsaker and Wilson on the behavior of aeroplanes in gusts. Messrs Herschel and Buckingham, of the U S Bureau of Standards contribute reports on the investigation of Pitot and Venturi tubes and other forms of anemometer A preliminary report on the meteorological relations of aeronautics is given by Prof Marvin, Chief of the Weather Bureau. Finally there is a voluminous memoir by Prof Charles E Lucke, of Columbia University, entitled "Thermodynamic Efficiency of Present Types of Internal Combustion Engines for Aircraft."

The administrative portion of the report contains a very well-considered summary of the work that lies before the committee, and makes a modest plea to Congress for enlarged facilities, including permanent headquarters in Washington and a staff of investigators and assistants able to devote continuous attention to the activities which the committee is supposed to direct. Some of the problems that urgently demand solution are the development of the mathematical theory of stability, the improvement of air-speed meters, the evolution of more efficient wing sections for aeroplanes, the development of high powered motors of light construction, improvements in the form of aeroplanes, the perfection of radio-telegraphic apparatus for aeroplanes, and the solution of a long series of detailed physical problems, relating to the various materials and methods of construction.

As illustrating the wide range of useful work cut out for the committee, it may be mentioned that this body proposes to collect statistics of aeronautical accidents in this country, and to make efforts to standardize legislation intended to guard against such accidents. The report states that "already a number of attempts have been made toward legislation in different states, *with the result* that in one state, at least, experimental work is practically prohibited, not because inventors and constructors cannot comply with the law, but because the operation of the law requires facilities which do not exist in the states in which the laws have been passed"

One important fact brought out by this report is that although the United States possesses many excellent potential agencies for carrying on aeronautical research, these have heretofore been utilized to a very limited extent for the purpose Many of our educational institutions have mechanical laboratories and engineering courses capable of application to aeronautics, but only the Massachusetts Institute of Technology and the University of Michigan so far offer a regular course of instruction and experimentation The statement is made that "in general, it appears that the interest of colleges is more one of curiosity than that of considering the problem as a true engineering one, requiring development of engineering resources, and, therefore, as not yet of sufficient importance to engage their serious attention" while "manufacturers are principally interested in the development of types which will meet Government requirements or popular demand, but which will not involve too radical or sudden changes from their assumed standard types"

We believe that the greatest need of aeronautics in *this country has been just such a body as the new* Advisory Committee, to serve as a clearing house of ideas as well as an active agency in directing and coördinating the work of American students and inventors The Government cannot afford to refuse liberal support to the organization which it has—with somewhat belated wisdom—created

Necessity of a Comprehensive Exploration of the Pacific

THE outstanding feature of the recent meeting of the National Academy of Sciences, in Washington, was the symposium on Prof W M Davis's *project of a comprehensive exploration of the Pacific*, with addresses by a dozen representatives of the various sciences that would be benefited by such an undertaking The project is still indefinite, and its realization, which would cost a great deal of money, is probably remote

Prof. Davis declares that many problems of the Pacific are not susceptible of solution by independent and short lived explorations, and that "future work should be broadly areal, rather than local, as on single islands, or linear, as in single voyages." He points to the magnetic work of the "Carnegie," with its repeated traverses of the ocean over many interwoven routes, as an example of the desired type of exploration, and suggests that the proposed work should be continuous through ten or twenty years Thus the enterprise which he wishes the National Academy to father is not another "Challenger" expedition, but something far more ambitious and thorough

The papers presented by the various specialists laid stress on the very fragmentary nature of the information we now possess concerning the largest of the oceans. For example, Mr Littlehales declared that "in the North Pacific there is a tract twice as large as the United States which has been crossed by only a single line of sounding, at intervals about 250 miles wide, and a number of instances exist in which tracts as large as the United States remain entirely unfathomed." The biology, geology and meteorology of this huge ocean are in an equally neglected state, while the anthropology of the Pacific islands bristles with a number of unsolved problems.

The conference in question was, in fact, devoted chiefly to taking stock of our present knowledge of the Pacific—or rather lack of knowledge It is somewhat discouraging to learn that the scores of famous expeditions that have scoured this ocean—from the days of the Spanish and Portuguese adventurers to the glorious age of Cook and La Pérouse, and onward, through the busy nineteenth century, to the present time—have accomplished relatively little.

Naval and Military Notes

A Fatal Compromise.—It is announced that the conferees on the army bill have compromised on a peace-strength for the army of 180,000 men. The House asked for 140,000 men; the Senate for 250,000 men, which latter the General Staff considered to be an irreducible minimum. The announcement that the 180,000 will be made convertible to a war-strength of 250,000 is a subterfuge. What the country needs is 250,000 regulars, fully trained and immediately available, should the thunderbolt of war strike without warning.

Looking Forward.—During the hearings on the Army Appropriation bill, Brig. Gen. Henry D. Sharpe, Q. M. Corps, recommended the purchase of $4,500,000 worth of cloth annually for four years at the end of which time there would be on hand a reserve amounting to $17,000,000. This would furnish the uniforms and tents for 800,000 men. The tents and uniforms, should war come, would be manufactured before the men could be enlisted and mobilized. The manufacturers of uniforms, etc., would be supplied with patterns and specifications and the clothing for a million men could be turned out in a few weeks.

The Threat of Militarism.—When the naval and military forces of a country take on a political character and are capable of exerting a strong political influence, that country is confronted with a sinister threat of militarism. It is the realization of this underlying principle that accounts for the growing hostility to the proposed mercenary federalization of the militia, as contained in the provisions of the Chamberlain and Hay bills. Under these bills a National Guard second lieutenant would receive $500 for seventy two hours' work and the pay to a private of the National Guard for seventy two hours' work a year would be equal to one quarter the wage of a regular army private for the entire year.

Loss of the Predreadnought "Russell."—In the sinking of the British predreadnought "Russell" by a mine in the Mediterranean the British Navy has lost its tenth capital ship since the war began. The others were the predreadnoughts "Irresistible," "Ocean," "King Edward VII," "Goliath," "Triumph," "Majestic," "Bulwark," and "Formidable." To these must be added the dreadnought "Audacious." The "Russell" was a small ship of 14,000 tons, designed in 1898, and she was therefore within a couple of years of the age limit. She mounted four 40-calibre 12-inch guns and twelve 6-inch guns.

Our Lack of Scouts.—"The mightiest battleship, unattended by numerous swift satellites is a blind behemoth, and a squadron of battleships without its proper complement of auxiliary craft, is constantly exposed to sudden disaster. This was a self evident truth long before the present war, yet it would seem to have been ignored by the American naval administration until very recently." Thus says the "Naval and Military Record" and the statement is correct, for out of our thirty two cruisers three only are able to steam at 23 to 23½ knots. We must lift our speed everywhere, for foreign navies have 25-knot battleships, 35- to 37-knot destroyers, 30-knot scouts and 18- to 20-knot submarines.

The Growth and Work of the British Navy.—Since the outbreak of the war the British Navy has shown a marvelous increase in ships and men. About 1,100,000 tons have been added in ships and the regular enlisted force has been doubled. Not only has the mighty German fleet been shut up in the Baltic but in practically every quarter of the globe the British fleet has been transporting troops and munitions of war and keeping open the trade routes of the world. The task in the Mediterranean alone has been a most serious one, as witness the statement of the First Lord of the Admiralty that 1,000,000 combatants, 1,000,000 horses, 2,500,000 tons of stores and 27,000,000 gallons of oil have been transported to the Mediterranean for the use of the British and their allies.

Increase in Battleship Size.—Not only is the United States building battleships of great displacement, as witness our "Pennsylvania" of 31,400 tons, but the other nations, with the exception of Great Britain, are keeping well abreast of us in this respect. Thus, the Russian Navy is completing this year four battle-cruisers of 32,200 tons. Japan has in commission her 30,600-ton battleship "Fuso," and she is building three others, due to go into commission this year and next, of 31,300 tons. Italy will complete next year four battleships of 30,000 tons displacement, and Germany, it is believed, has completed since the war began three ships of close to 30,000 tons. The Japanese ships are to have a speed of 22.5 knots, the German, 23 knots, the Italian battleships, 25 knots, and the Russian battle-cruisers, 25½ knots.

Astronomy

A Harmless Zeppelin.—The striking spectacle presented by Venus and Jupiter in close proximity to each other in the evening sky on February 13th and 14th led to needless perturbation in many parts of France, where the two planets were mistaken by the unastronomical majority for the lights of a Zeppelin. At Rouen the alarm was complete, the approach of the hostile craft was announced by the firing of a cannon, the fire department turned out and the people were not reassured until the planets had sunk peacefully below the horizon.

A Rapidly Moving Faint Star.—Comparison of two photographic plates of the region around Alpha Centauri, taken at an interval of 5.3 years, has, thanks to the blink microscope, resulted in the discovery of a faint star having the remarkable proper motion of about five seconds annually. Only five other stars are known to have proper motions exceeding this value, and they are all much brighter than the star in question, the photographic magnitude of which is 12.0 on the Harvard scale. This discovery was made by Mr. R. T. A. Innes, of the Union Observatory, South Africa.

Finding Your Way by the Stars.—The need of soldiers, when marching or scouting at night, for a ready means of keeping their bearings is designed to be met in a little book recently published in England by R. Weatherhead, entitled "The Star Pocket-book." This book not only serves as a guide to the constellations but also shows how the stars may be used for determining time and directions. There are tables showing the dates when certain stars cross the meridian at midnight and the highest altitudes of stars in various latitudes. There are also lists of "simul transit pairs," i. e., stars which transit at the same time and which, when vertical, mark the meridian.

The Photo-electric Photometer.—The use of the very sensitive photo-electric cell in stellar photometry was first suggested less than three years ago and has thus far been realized most successfully by Messrs. Guthnick and Prager, whose results were published in Vol. 1 of the publications of the Babelsberg Observatory. The improvement of this instrument has recently been undertaken by Prof. Joel Stebbins, who has been so prominently identified with the selenium photometer. A form of the instrument, as perfected by Professors Stebbins and Kunz at the University of Illinois was used last summer with the 12-inch refractor of the Lick Observatory in measurements of the light-curve of Beta Lyrae, and an account of this work has just been published as a Lick Observatory Bulletin. The instrument consists essentially of a rubidium cell in direct connection with a string electrometer which hangs in gimbals on the end of the telescope. It is very sensitive to the effects of moisture but no trouble from this source was experienced in the dry air of Mt. Hamilton. It has a color sensibility about half way between the visual and photographic methods of photometry. The measurements on the variable star Beta Lyrae which has a period of 12.92 days were made on 34 nights and while agreeing in general with previous visual measurements show a number of curious irregularities that demand explanation.

Albedo of Planets as an Indication of Rotation Period.—A note by Mr. W. F. A. Ellison in the *Journal* of the British Astronomical Association argues against the long rotation period (equal to the period of revolution) sometimes ascribed to Venus. If the planet always turned the same face to the sun the illuminated hemisphere would probably be without moisture while the dark hemisphere would be in a state of permanent glaciation. Water once conveyed to the dark side would remain locked up there as eternal ice. Evaporation from the ice at the temperature of space and under an atmospheric pressure probably much greater than that at the surface of the earth, would be almost *nil*. Hence the illuminated side of the planet should be entirely free from cloud, and we would see the actual surface of the planet just as we see that of the moon. If this were the case Mr. Ellison believes that it would be impossible to explain the high observed albedo of Venus since "there is no known substance, of which a planet's surface could conceivably be composed, which could reflect light as the surface of Venus reflects it." The high albedo appears to mean that what we see on Venus is a layer of cloud. This is, of course contrary to the views of Lowell and others, who think they have observed permanent markings on this little-known planet. Similar considerations make it necessary to reject the hypothesis of M. Amaftounsky regarding the markings of Jupiter. The albedo of this planet even higher than that of Venus, indicates a cloud surface, such as has been assumed by nearly all modern astronomers. On the other hand, Mr. Ellison finds on the surface of Mars, as seen with his 18-inch reflector, spots so dark that their albedo must be not far from zero, and this, he believes, indicates deep water—in other words, seas—instead of the tracts of arid land of current interpretation.

Radio Communication

Government Experiments with Direction Finder.—It is reported that the United States Government is conducting a series of experiments with direction finder apparatus installed in the radio station situated at North Truro, Mass. The purpose of the experiments is to enable navigators to send signals to the wireless station and then be told the vessel's bearing.

Early Direction Finder Patents Sustained.—The priority of invention by Alessandro Artom of triangular dirigible aerials and the radiogoniometer as set forth in Italian patents Nos. 88,765 and 88,766, French patent No. 378,180, and German patent No. 203,139 has been sustained by the Italian courts recently. Bellini and Tosi, whose work in developing systems of wireless direction finding is well known, heretofore have claimed priority in the case of the radiogoniometer, which is the essential instrument in their system.

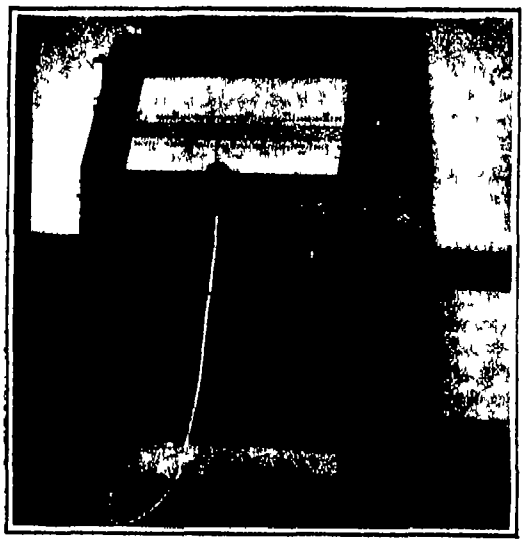
Review of Wireless Telegraphy.—The United States Bureau of Navigation has issued a monograph entitled "Important Events in Radiotelegraphy," which gives besides the history of the wireless telegraph itself, the important steps in electrical development which led logically to the invention of this means of communication. There are special chapters on "Some Recent Developments," "Radio Inspection Service" and "Wireless as a Safeguard to Life at Sea." There are fourteen pages of events by dates. Copies of the publication may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at five cents each.

Proposed Wireless Stations for Spain.—According to information recently published in the official organ of the Seville Chamber of Commerce, a company has been organized with a view to operating wireless telephone systems in the different cities of Spain and to connect with the Spanish vessels and Spanish colonies in Africa. The proposal contemplates the erection of stations in the cities of Cordoba, Seville, Cadiz, and Huelva and 29 other stations in other parts of Spain, in the Canary Islands and at Tangier, Melilla, Ceuta, and Ibiza in Africa. The first class stations are to be of 5 kw. and the second of 2 kw. rating.

A Detector Based on New Principle.—There has recently been perfected a crystal detector the operation of which is based on an entirely new principle. Instead of the crystal coming in contact at one point only with a sharpened metal rod or fine wire, as is usually the case, the surface of the crystal makes contact with the minute particles of a finely divided alloy. Thus there are almost innumerable contacts in the detector, which is made in the form of a small insulated disk with a knurled edge for adjustment purposes. To adjust the detector, it is only necessary to turn the disk slowly while listening to the varying strength of the signals in the telephone receivers.

Radio Communication in the North Sea.—The story of a correspondent who spent an evening in the wireless room of a British battleship stationed in the North Sea illustrates the great range of many present day radio stations. On that particular evening, which he admits was unusually favorable to wireless communication, he heard Poldhu, the Welsh station of the Marconi chain; Nordeich, the German station from which the Teutonic version of the war is sent out daily to ships at sea; the Eiffel tower station at Paris, which handles a goodly part of the French Government's orders to distant commands; the Spanish station at Madrid, the Russian naval commander in the Baltic, as well as the admiral of the British Grand Fleet, the German commander-in-chief with his land-locked fleet and the British commander-in-chief in the Mediterranean. The correspondent comments on the ease with which the operator was able to tune in any desired station while eliminating the others.

How the "Goeben" and the "Breslau" Evaded the Allied Fleet has until now remained a mystery, although everyone has heard of the successful dash of these two German warships from an Italian port to Constantinople despite the seemingly impenetrable net of Allied fleets during the opening days of the great war. A book which is attracting much attention in Germany contains a semi-official history of the adventures of these two famous ships. According to its author, Emil Ludwig, the German Admiral's strategy was to give the enemy the impression that the Teuton fleet was making for the Adriatic and then suddenly swing east in a dash for Constantinople. However, an English cruiser happened on the spot and saw the maneuver when the ships swung into another course. And to prevent this warship from signaling to the British ships which were waiting off Malta and the Straits of Otranto, the German radio operators received orders to "jam" the enemy messages which they are said to have successfully accomplished. As a result, the all important dispatches were not received until hours later, when all chances of intercepting the fast German ships were gone.



Standard model tonoscope, suitable for voice culture

Using the Eye Instead of the Ear in the Training of a Musician

By Carl E. Seashore

A DEAF person can now train himself or herself to sing or play any instrument correctly without the aid of an instructor In other words the study of music has been reduced to a science and instead of depending upon the sense of hearing for determining the purity or correctness of a sound, the eyes are resorted to in studying an animated screen.

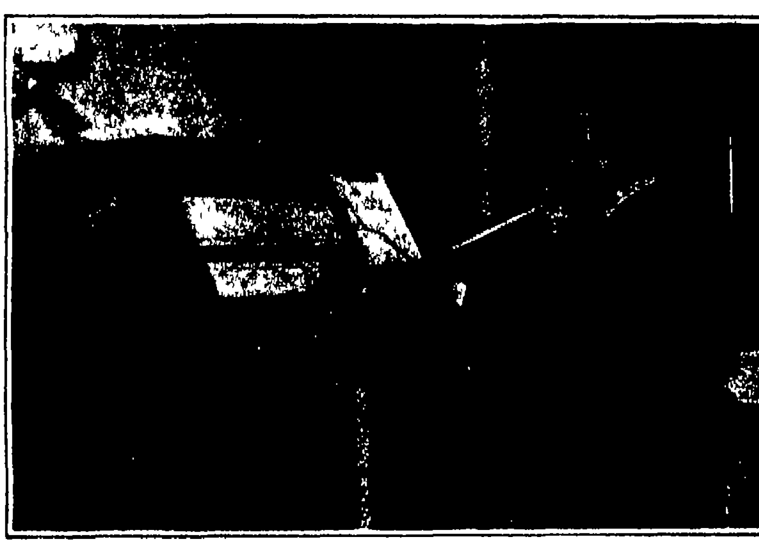
The device which has made the foregoing possible is known as the "tono scope," and although it is not, strictly speaking, a novelty since the first model was built in the psychological laboratory of the University of Iowa in 1902, it is of current interest because of its recent de velopment to the commercial stage

The tonoscope works on a principle analogous to motion pictures, technically known as stroboscopic vision It converts the sound vibrations into pictures on a screen The screen, which may be seen through the opening on the front of the tonoscope, has 17 500 dots which are so placed that, when acted upon by a sen sitive light, they arrange themselves in characteristic figures for every possible pitch within the range of the human voice Each figure on a graduated scale points to a row of dots on the screen which indicates the pitch The dots are arranged in 109 rows the first row com prises 110 dots, the next row 111 dots, and so on, each successive row having one more dot than the preceding one until the last row is attained which comprises 219 dots When a sound of a particu lar pitch is caused to act on the tonoscope, the row which has the dot frequency that corresponds to the vibration frequency of the tone appears to stand still, while all the other dots continue to move, and thus tend to blur It is the row which "stands still" that indicates by a corre sponding number on a scale the pitch of the tone The screen is arranged for readings covering but one octave, but tones above or below the octave can be read on the same screen by multiples The conditions under which a reading is made with the tonoscope are absolutely natural, since in conjunction with a de tectaphone, acousticon or even the or dinary telephone the tone may be reg istered without the use of a speaking tube or horn, and even from a distant point.

The mechanism of the tonoscope is not as complicated as might be supposed at first The revolving screen carrying the dots is driven by a synchronous motor which runs in step with a 10 v d tuning fork The sound waves to be analyzed cause a manometric flame to flicker and the resulting intermittent light selects those moving objects which synchronize with the vibrations of the tone and the light The manometric capsule used may be equipped either for the direct trans mission of the sound waves through a small trumpet, or it may have electrical connections with a highly sensitive tele phone, as previously mentioned

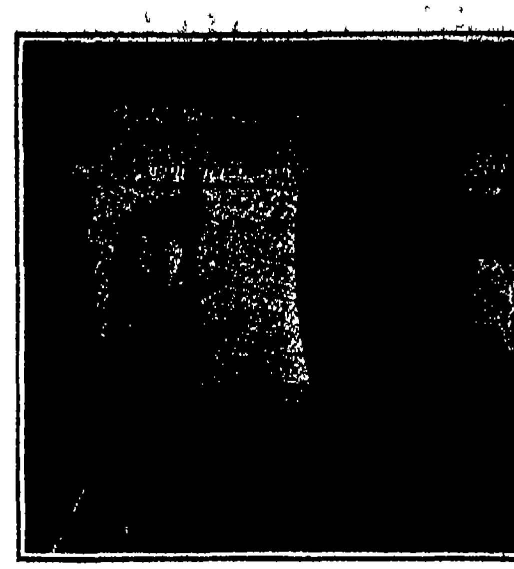
The reading of the apparatus, which is in terms of vibrations and the accuracy of which varies with the steadiness of the tone measured, is instantaneous. The moment one sings or plays a note the pitch of that note in terms of the number of vibrations per second can be instantly read. The record of the instrument is very much finer than the ear can hear, accordingly, it not only furnishes an objective record of pitch, but also magnifies details. The tone from a tuning fork can be read to an accuracy of 0 1 of a vibration, the fractions of vibrations being obtained by timing the passing of a slowly moving dot.

It is only recently that the tonoscope has been developed to a point where it may be used for teaching the inflections of the voice to the deaf It seems that this appeal to the eye will furnish a short cut and, indeed, new possibilities for attainment in pitch con trol of the voice of the deaf. The tonoscope is also available for the conservatory, where it serves a wide variety of purposes not the least of which is the development of the voice A singer, standing before the instrument, sees in clear form every pitch movement of the voice he sees exactly how many vibrations per second the vocal organs are producing, and thereby can tell, at the very moment of singing a note, what error is involved even down to the hundredth of a note The singer can practice before the instrument by the hour with the opportunity of seeing the error in every tone, and controlling the voice and the ear by the eye He can study in detail the attack, the sustaining, and the release of a single note. Likewise can the player of the violin, flute, cornet, or any other musical instrument use the tonoscope to advantage. A scientist or a musician may take a phonograph record of the tonal effects under observation and ship the



Deaf person learning the inflection of the pronoun, "I," for which he has a diagram at the right. He practices until his voice produces the same diagram on the tonoscope

cylinder to the laboratory where it may be reproduced upon the tonoscope. The student of primitive music can transcribe the phonograph record by this method, while the scientist can undertake technical studies on pitch which involve exact measurements and instantaneous recording in actual singing Again, the student of public speaking can study the inflec tions of the voice objectively and train for mastery Finally, the teacher of the deaf can place his pupil before the instrument, and train him to speak with pleasing inflection of the voice by practicing with the aid of the eye. These applications, it is believed by the author who, in conjunction with Dr C. F Lorenz, has invented the tonoscope, are but a few of the many uses to which the instrument will ultimately be put. It would appear that it is not in the adapting of the tonoscope to various purposes that ingenuity will have to be exercised in the future, but rather in finding almost countless new uses for this valuable apparatus



Simple model of the tonoscope, showing the mechanism

Seaweeds as a Commercial Fertilizer

IT is reported by the United States Con sul stationed at Yarmouth, Nova Scotia, that through experiments with seaweeds by the Dominion Government Reduction Works at Clark's Harbor, N S, it is found that they are rich in potash and possess a considerable quantity of nitrogen and phosphoric acid Seaweeds in their natural state have long been used by farmers in Nova Scotia for manurial purposes, and the fact that they readily decompose when spread upon the ground seems to enhance their value as a possible commercial fertilizer Fresh seaweeds, however, contain 65 to 85 per cent of water, which makes it unprofitable to ship the fresh material any distance inland The government is now trying to find a method by which seaweeds may be dried and ground economically

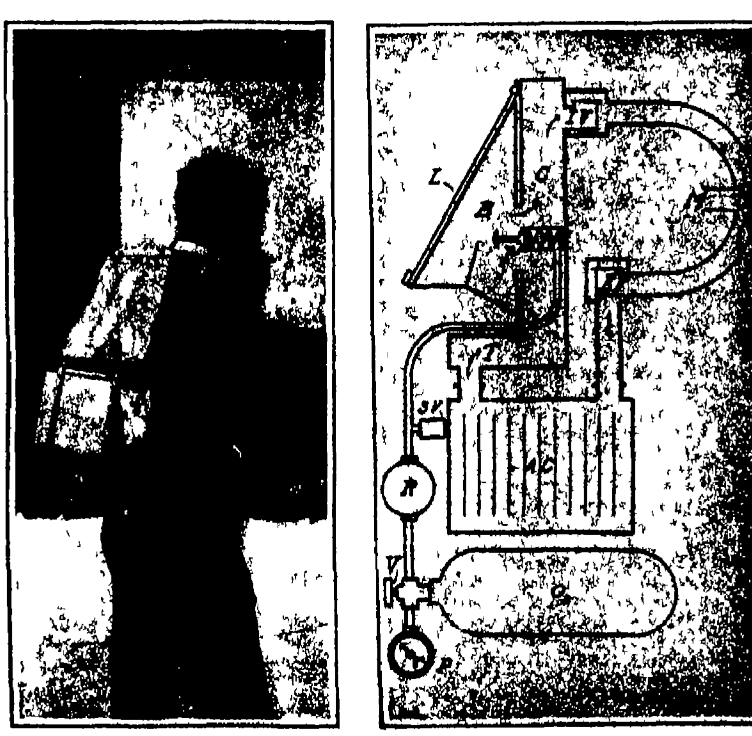
Recent Developments in Mine Breathing Apparatus

THE United States Bureau of Mines announces the completion of a new breathing apparatus which has been developed after much study and experiment. In January, 1914, the Director of the Bureau of Mines commissioned Mr Wm E. Gibbs, a mechanical engineer of New York City, to undertake the investigation of the problems involved and to construct a new type of apparatus in which the results of his research should be embodied. Columbia University very kindly placed a laboratory at the disposal of the Bureau of Mines for this purpose. The result of all this is a self-contained, automatically regulated apparatus carried wholly on the back of the user The new equipment is believed to set a new mark in the field of mine breathing apparatus.

Rescue crews have to do hard work in the poisonous atmosphere of a mine after an explosion or fire, and the breathing apparatus they wear must be of the best design and construction. It must be absolutely reliable, it must supply an artificial atmosphere of great purity, it must be as light as is consistent with strength, and it should impede the movements of the wearer as little as possible.

A few words on the process of respiration will help to make clear what follows:

Normal air contains 20 per cent of oxygen mixed with about 80 per cent of nitrogen and a trace of carbon dioxide. At each inspiration part of the oxygen combines in the lungs with carbon, which is brought to it by the blood, and the air when expired contains about four per cent of carbon dioxide. The nitrogen of



Mine breathing apparatus developed by the Bureau of Mines, showing the equipment with the cover removed and a diagrammatic explanation of its operation

the air is unchanged by the act of respiration and takes no active part in it

For all practical purposes an artificial atmosphere of pure oxygen, or oxygen containing only a small percentage of nitrogen, is actually preferable to normal air under the conditions surrounding mine-rescue work. In spite of the general belief that pure oxygen is unsafe to breathe, no abnormal effects attend its use unless it be breathed for a much longer period than that during which rescue apparatus is customarily worn, and even then the only symptom noted is a slight irritation of the bronchial passages.

The amount of oxygen consumed in the body is precisely the same when the gas is breathed in a pure state as when it is diluted with nitrogen in the form of air There is no flushing of the face, no feeling of exhilaration, no increase in the pulse rate, nor elevation of arterial tension. It is only a few years since the reverse of each of these statements was believed.

If, on the other hand, the oxygen content of the air be materially reduced, unconsciousness and death are almost sure to follow without any warning symptoms, provided the carbon dioxide content is kept low For this reason it is advisable that breathing apparatus shall supply an atmosphere rich in oxygen. Moreover, much of the oxygen that is made from liquid air contains two or three per cent of nitrogen, and as this remains unchanged in the apparatus, analyses of the air breathed by the wearer generally show a decreasing oxygen content proportionate to the length of time the apparatus has been used If the proportion of carbon dioxide in the artificial atmosphere rises much above two per cent, deeper breathing or panting warns the wearer of danger, generally in time to let him get to safety

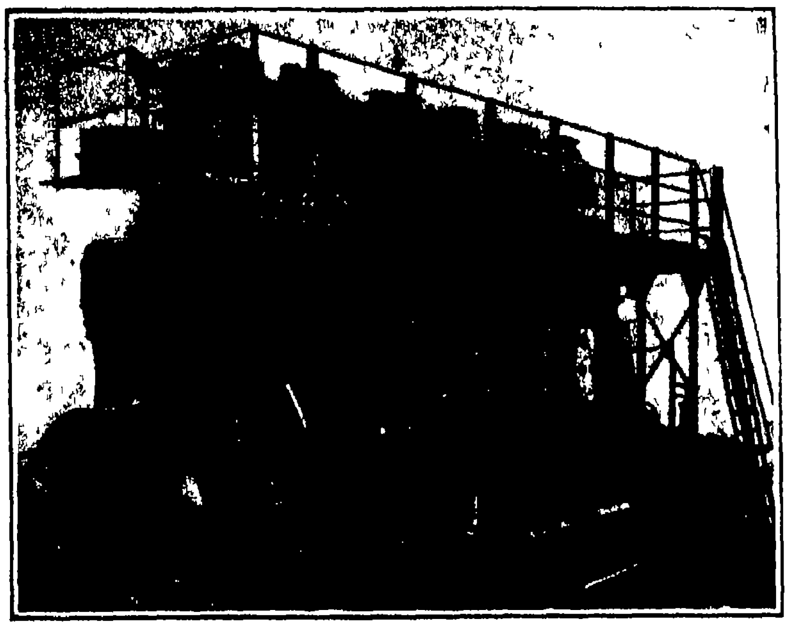
The elements that enter into the construction of the Bureau of Mines breathing apparatus are shown diagrammatically in the accompanying drawing The apparatus is supposed to be full of oxygen and to have a considerable surface of caustic soda exposed in the absorbing cartridge *AC*

When the subject inhales through the mouthpiece *M*, the valve *IV* opens and oxygen passes from the bag *B* through the cooler *C* to the lungs On exhalation the oxygen, somewhat diminished in volume and containing about four per cent of carbon dioxide, issues from the mouth The valve *IV* now closes, but the valve *EV* opens to let the mixture of O_2 and CO_2 gases pass into the absorber *AC*, where the caustic soda combines with the carbon dioxide to form sodium carbonate (Na_2CO_3) with the formation of some water and the liberation of heat. In existing types of breathing apparatus potash salt, which is more expensive, is used

Thence the purified oxygen passes by way of the duct *T* to the breathing bag *B*, which expands to make room for it. The total volume of gas then in the apparatus is less than the original volume of carbon dioxide taken up by the absorbing can After the wearer of the apparatus has taken a few breaths, the bag *B* collapses sufficiently to permit the weighted lever *L* to open the oxygen admission valve *I*, when the bag *B* fills again automatically The heat generated in the absorber is removed from the gas by radiation, partly from the cooler *C* and partly from the bag *B* and the connecting tubes. A reducing valve *R* lowers the pressure of the oxygen from about 2,000 pounds per square in in the bottle to a pressure that may be controlled by the admission valve *I* A pressure gage *P*, indicates the available oxygen The gas may be turned off by the stop valve *V* when the apparatus is not in use. *SV* is a safety valve with a whistle in its outlet, which blows off at half an atmosphere. The whistle is to give warning of leakage at the reducing valve.

Breathing apparatus, as previously constructed, employed a constant flow of oxygen from the tank of compressed gas, not because such a flow is desirable, but because of the difficulty of making a reducing valve that permits the flow to be interrupted. With such a system it is necessary to set the valve to deliver oxygen at a rate that supplies the demands of the wearer when putting forth his utmost exertion. At all other times the supply is excessive and the surplus must be allowed to escape through a relief valve. Besides being wasteful of oxygen this method causes considerable fluctuation in the pressure within the apparatus, and at all times makes breathing difficult. Thus, one of the most important parts in the new breathing apparatus is the reducing valve which represents a long series of experiments When the reducing valve is attached to a cylinder of gas at a pressure of 150 atmospheres the pressure within the bellows, when the outlet is closed, is about one sixth of an atmosphere This remains constant even after the outlet has been shut off for several hours Such a reducing valve makes it possible to admit oxygen intermittently to the breathing bag in the exact quantity required by the user under conditions varying from complete rest to extreme labor

Exhaustive tests with the new apparatus which weighs 30 pounds complete, are reported to have demonstrated its superiority over most existing types



Large two-cycle Diesel engine of 2,300 indicated horse-power, two of which are installed in the Brazilian submarine depot ship "Ceara"

Photo copyright, Brown & Dawson

Frame of an electric generator with the pole pieces in place

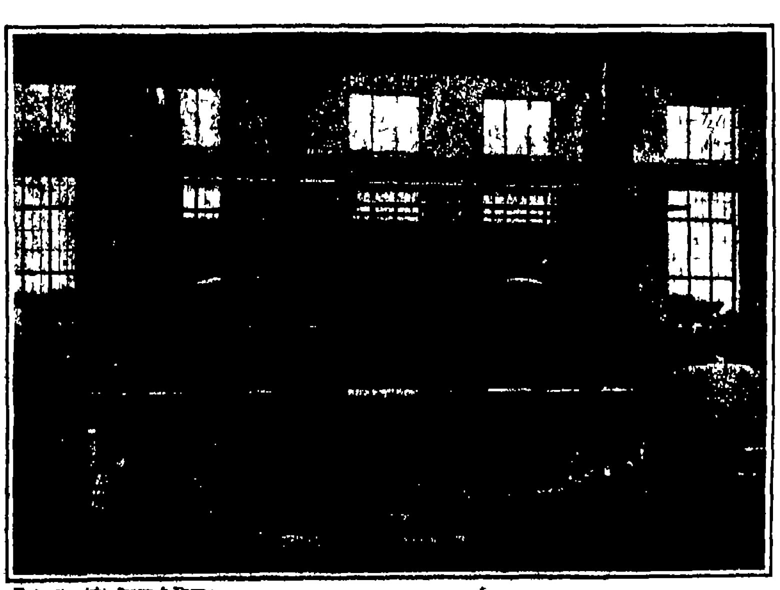


Photo copyright, Brown & Dawson

Horizontal lathe finishing the frame of a huge electric generator

A Giant Diesel Engine

THE internal combustion engine, on account of its immense usefulness and universal applicability, occupies a great amount of public attention and those engaged in producing this class of motors are generally assumed to be in the forefront of mechanical progress But a survey of the entire field, including every class of motor raises the question whether the progress so far made has been adequate or commensurate with what might reasonably have been expected

Except in a few directions the impression forces itself that practically there has been no radical improvement in the internal combustion engine for many years and that such progress as has been made has been almost entirely in the direction of refinements of old principles and designs and more accurate workmanship, and in these lines there has been more of imitation than originality Possibly one reason for this is that the builders of engines have exploited particular limited types so intensively that they neither care nor dare to make any material changes, for it is notably difficult to induce the buying public to move in a new direction, no matter how much to its advantage.

Unfortunately there is, aside from these commercial considerations, another side of the matter that directly concerns the engineer, and this is his conservatism, and even narrowness of view To be definite, the case of the four and the two cycle motor may be cited It is obvious that an engine that gives but one working stroke out of four is a mechanical anomaly, and yet we hear of no effort to make any change, and although the two-stroke principle is theoretically twice as efficient as the four stroke even this improvement is not only disregarded by the majority of gas engineers, but even condemned out of hand by men who have practically no knowledge of the subject If a fraction of the investigation that has been given to the four-cycle machine had been devoted to the two-cycle principle it is safe to say that the two-cycle engine would have superseded its more popular brother in many directions before this

What can be accomplished in designing an engine on the two-cycle principle is shown by a pair of large motors recently built in Italy for the Brazilian navy, notwithstanding the often repeated statement that the two-cycle Diesel engine was a failure, and their construction has been entirely abandoned. These engines, which are for the submarine depot ship "Ceara," are not only the largest marine Diesel engines yet built but they are also the most compact, the lightest and the most economical, and withal, the simplest.

The "Ceara," for details of which we are indebted to *Engineering* is a vessel of 326-foot length and 4 100 ton displacement and is powered with two two-cycle engines of the Diesel type each of 2,300 brake horse-power when turning 130 revolutions a minute The cylinders, of which there are six in each engine are 24 8 inches diameter and 35 4 stroke, and 384 brake horse power is obtained from each cylinder without overloading them The four cycle engines of the "Fiona," one of the largest of its type, with cylinders of 29 13 by 43.30 give but 270 brake horse power each Some other comparisons with a six-cylinder four-cycle engine of 1 450 brake horse power are interesting The "Ceara" engines are 30 feet 6 inches long over all, and 16 feet 0 inches total height from center of crank shaft with an over all width of 7 feet. The four cycle machine is 46 feet in length and 18 feet high, with the same width The "Ceara" engines weigh 155 pounds per brake horse-power, while a four-cycle engine of equally solid construction would weigh 250 to 350 pounds per horse-power

The Electrical Industry in Belligerent Germany

DESPITE the great numbers of men who have been drafted into the army and the tremendous demand for war material that has caused almost every machine shop of any importance to be converted into an arsenal, there is being produced in Germany much electrical machinery to which the two accompanying illustrations bear evidence

Measuring over 35 feet in diameter, the frame of the generator shown in the two views represents an interesting piece of mechanical work The rough castings comprising the frames have been finished in a gigantic horizontal lathe, after which the pole pieces are bolted in place, ready to receive the coil windings.

Strategic Moves of the War, May 5th, 1916

By Our Military Expert

AFTER almost five months of siege the British forces under General Townshend at Kut el Amara have been compelled to surrender This force which originally constituted the flying column which attempted to take Bagdad, was reduced at the time of surrender to something less than 10 000 men. Shrinking to this almost negligible number of men was brought about by losses incurred during the advance on Bagdad the retirement from Ctesiphon and the subsequent investment of Kut

General Townshend's surrender was primarily caused by lack of food, ammunition and the dearth of equipment to meet sanitary needs His lines of fortification were not carried by the enemy, no assault which the German led Turkish forces were able to launch had more than dented his defenses, there was no chaotic crumbling of his stronghold beneath the pounding of superior artillery In the strictest sense the downfall of this force was not accomplished by a feat of arms for the seasons and the flooding of the lowlands by the waters of the Tigris thereby preventing the relief expedition from reaching Kut, although at the time of the surrender it was held by the Turks less than 20 miles away, combined to create a situation wherein the shaking of England's prestige in Asia became an accomplished matter

The position at Kut is a strong one in a military sense, for the Tigris makes a great loop at this point which in itself establishes a safeguarding obstacle With the massing of Turkish forces south of Bagdad the expeditionary forces of which this surrendered 10 000 is but the remnant were forced to beat a hasty retreat, only daring to pull up when this strong position of defense was reached Kut had been a basic point and with its occupation in force by the British, quantities of supplies and ammunition were sent up by boat The augmented Turkish forces were then able to surround the position entirely whereby all means of reaching the besieged without successful and personal escort by a powerful relieving column, were out of the question with the personal valor which has signalized the stand of Englishmen on every field of battle the depleted British forces settled down behind their lines There is a tradition of Great Britain's that if any besieged forces can but hold out for sufficient time, relief columns will hew a way through True to form as soon as news of the Kut investment became known a more powerful relief column was dispatched to its aid from the head of the Persian Gulf But the forces of the Ottoman had gathered, the organization of Teutonia had come to weld the loose parts and the English force was held away from its objective in this case by force of arms Townshend's supplies were rapidly becoming scarce efforts were made to relieve the wants of his men by sending them small quantities of food and medical necessities by aeroplane but for some reason this was a failure All the time through the long weeks and months, the British kept up hope They could clearly hear the guns of the relieving column engaging those of the Turks, so near to the southward their scant rations were halved that a few more days of endurance might be provided In a desperate attempt to reach Kut a ship laden with necessities was sent up the Tigris, with the deliberate intention of running the gauntlet of Turkish fire, but as the beleaguered garrison watched and prayed, the ship grounded only 4 miles away, and with this deprivation hope fled and Townshend surrendered rather than see his men starve

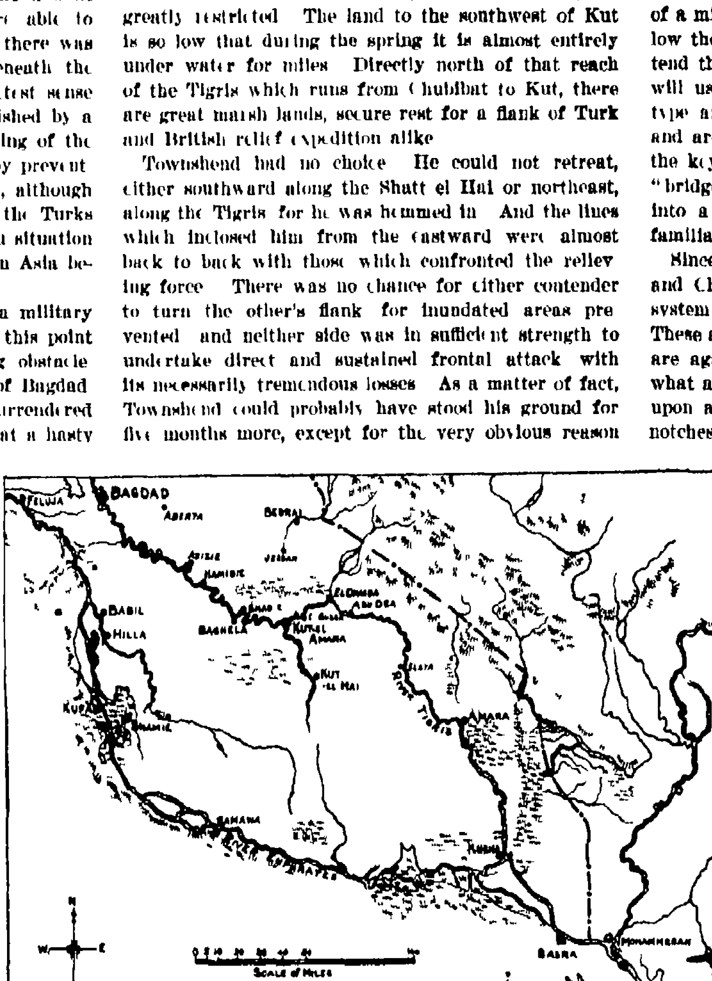
This expedition has been called another piece of Great Britain's folly For decades England Russia and Germany have contended diplomatically for the hegemony of Asia Minor—with all apologies to Turkey To date English influence has somewhat overshadowed that of Russia Germany's hold on this section has been almost entirely commercial, abetted by a very quiet and able diplomacy

What seemed a splendid opportunity for physical control presented itself and with customary disregard of conditions, England dispatched an utterly inadequate force in a thrust toward Bagdad, and Kut el Amara is the result With the great Russian armies of the Caucasus *so far victorious sweeping down, to* the northward, the possibility of England's political predominance in this section seems to have vanished in Russia's *favor* As *possession* is nine *points* of the law, even of nations Germany's claims may not be advanced unless a general decision is obtained by her

With no bias in favor of Teuton or *Entente*, this miserable failure in Mesopotamia adds but another link to the chain of errors which Great Britain seems to have forged since the war began There were grave differences of opinion between the British and the French commanders during the retreat from Belgium, wherein the safety of the entire line was jeopardized, with England unaccountable. The Dardanelles fiasco was Britain's naval and land, and now, Mesopotamia! England has not yet become enough of a military machine to meet the needs of the day

The character of the country in the vicinity of Kut el Amara is such that military movements must be greatly restricted The land to the southwest of Kut is so low that during the spring it is almost entirely under water for miles Directly north of that reach of the Tigris which runs from Chubibat to Kut, there are great marsh lands, secure rest for a flank of Turk and British relief expedition alike

Townshend had no choice He could not retreat, either southward along the Shatt el Hai or northeast, along the Tigris for he was hemmed in And the lines which inclosed him from the eastward were almost back to back with those which confronted the relieving force There was no chance for either contender to turn the other's flank for inundated areas prevented and neither side was in sufficient strength to undertake direct and sustained frontal attack with its necessarily tremendous losses As a matter of fact, Townshend could probably have stood his ground for five months more, except for the very obvious reason that his men must live to fight, and must eat to live, he was starved out



Scene of the British failure in Mesopotamia

While it is true that climatic reasons had much to do with the failure of these last British operations, had the Bagdad venture been delayed until an adequate force—say that which attacked the Dardanelles—had been assembled for the purpose then the movement would probably have carried through

From a military point of view, the loss of Townshend's *force is of* comparatively little moment an ordinary assault at Verdun has cost far more And it is to be doubted whether the Turkish forces released *for activity in other fields* by the *surrender* are sufficient to materially sway any balance, England's relief column is too close at hand to be neglected and Russia's *columns,* reaching *toward* Bagdad *from* Kermanshah are not alone, for they are supported by others north and south

The cost to England therefore *of* this, her latest failure, will probably not have to be paid during the war, but if the *Entente* should win in the end, the bill will be *presented, for* Russia *should* then hold the proverbial "Nine Points of the Law" the physical occupation of Asia Minor, to England's exclusion.

Automatic Type-Setting Machine for the Oriental Languages

A RECENT issue of *Commerce Reports* contains a number of interesting facts concerning the "Orientype," an automatic type-setter designed to set up the thousands of *type characters* used *by* Japanese, Chinese, and Chosen printers.

According to the correspondent writing in the *Commerce Reports, one of* the new machines has been set up recently in the printing office of the *Hawaii Shinpo,* a Japanese daily published in Honolulu S. Sheba, editor of the *Hawaii Shinpo,* was at last able to realize in material form the dream of years—a machine which he believes will revolutionize Oriental printing—after a visit to the Panama Pacific International Exposition at San Francisco in 1915 He visited Machinery Hall many times, and after seeing so vast an array of machines he was able to formulate in his mind the manner in which some of the intricate parts of his typesetting invention should be made. Under his personal supervision the original model was made in Honolulu, and a real machine was manufactured in San Francisco The inventor purposes to obtain a patent.

The "Orientype," to some extent, has the appearance of a miniature Brooklyn Bridge In the center and below the "bridge" appears a keyboard This is to extend the full length of the "bridge," and the operator will use a sliding seat set in grooves. The pieces of type are placed in rectangular-shaped tubes of brass and are released by springs, in their turn released by the keyboard The type is carried to one end of the "bridge" on a perpetual belt carrier and then falls into a part of the mechanism which resembles the familiar matrice-assembling mechanism of the linotype

Since there are 5 000 characters in use by Japanese and Chinese printers, Mr Sheba has also invented a system of classification of type into about 100 units These are collected in the rectangular tubes The tubes are again classified by notches on the outside, somewhat after the form of those on Yale keys. These fall upon a set of wires and are carried on these by the notches In this way the filled tubes are classified, and the operator selects a number of tubes, places them over the type-setting machine, their lower openings set so that the springs released by the keyboard set them upon the endless belt, and the characters are carried to the receiving fonts

The inventor is preparing his machines so that in the near future, with the models in a commercially successful form his product will be disposed of not only in Japan, China and Chosen, but also in the United States, as there are Oriental printing companies upon the American mainland He hopes to displace the old laborious system of selecting, setting up, and assembling type characters

American printers who have read the meagre details available concerning the "Orientype" are of the opinion that the machine should be a very expensive one to build Further, they claim that its very complexity may stand in the way of its universal adoption, for the Oriental printers may find hand setting cheaper than the cost of operating the machine. Obviously, of course, their opinions are based only on the facts available

Soldering of Aluminum as a Substitute for Welding

BECAUSE of the impossibility of soldering aluminum satisfactorily in the past, this metal has not been used to the extent that its high utility otherwise justifies. Workers in aluminum have heretofore been obliged either to weld aluminum pieces together or to resort to a more or less satisfactory soldered joint, the latter difficulty being due to the impossibility of keeping the metal free from oxidization

There has recently been introduced a new form of aluminum solder for which the claim is made that it will not only join two pieces of the metal together every time, but it will also make a joint that will be stronger than the aluminum parts The new solder will do a better, quicker, neater, stronger, less expensive and more lasting job than by the welding process, it is claimed

The new aluminum solder is said to be the only solder that runs at a very low temperature, and when cold is not only harder than aluminum but has more than twice the strength A simple experiment that shows how much stronger the soldered portion is than aluminum *itself* is to solder two pieces of sheet or cast aluminum at right angles to each other When the soldering is complete, an attempt is made to break the two pieces apart. Invariably the aluminum pieces will break before the soldered portion.

The simplicity of soldering with the new aluminum solder is another point in its favor All that is required is a gasoline torch. The job to be done is heated; then, with slight rubbing with a hack-saw blade or a piece of iron, the metal and solder will combine without a flux of any kind.

War Game—IX

The Defense

By Lieut Guido von Horvath

THE general principle of the defensive is to utilize all of the advantages of the situation both tactical and strategical, with the intention of assuming the offensive when the opportune time arrives.

Under some conditions, defensive positions may be selected and prepared far in advance. In other cases, the commander of the forces which are obliged to remain on the defensive for the time, may maneuver so skillfully as to enable him deliberately to occupy certain positions which the enemy must either attack or fail to accomplish his mission

Again, the commander is liable sometimes to lose the initiative and he may be compelled to accept battle on the ground available. In this latter case, a successful defensive is most difficult.

But in all cases, the underlying principle of the defensive must be the same. Its aim must always be to hold the initiative or to gain it

It makes no difference what natural or artificial advantages are in question, the loss of liberty in maneuvering and the possible lost initiative are not compensated by the best defensive position

Therefore, the sole reason for taking up a defensive position should be to hold the enemy by means of smaller forces in such a way that after equalization of the defensive combat, the defending force may undertake the more active operations necessary to win a decisive victory

Selection and Preparation of a Defensive Position

The first duty of the commander is to secure all the information available as to the enemy To secure this information, the intelligence department, cavalry and aerial reconnaissance must be utilized.

The most important items of information to be secured are the lines of approach of the enemy and the strength of his forces. Until this is learned it is better to keep the force in a position of readiness under the protection of a strong outpost line. Thus the forces are kept in hand ready for any emergency

The amount of preparation depends mainly on the time available and the demands of the task to be under taken. In choosing the defensive position, great care should be exercised not to make the line too long to be held by the force in hand By lengthening the line and thus requiring the services of too many of the troops to hold it, the chance of assuming the offensive will diminish. It is evident that a long line will be a weak line.

In selecting a defensive position, the terrain and its natural advantages or disadvantages must be first considered. An effective fire being the most decisive factor in a defensive action a clear field of fire both to the front and flanks, without cover for the approach of the enemy, is the first requisite

When selecting a defensive position, the artillery should be so located that it may direct its fire upon the advancing enemy until the last moment in case of an assault, without interfering with the action and fire of our own infantry A position should be chosen the terrain of which will permit and if possible favor a counter-attack. If there is any chance for an enveloping movement by the enemy, or for an enfilading fire by him, the defensive line is exposed to a grave danger

The defenders must retain their liberty for maneuvering. This is dependent upon the depth of the position and means of communication under cover.

Cavalry can be of great use to the defense in delaying the enemy, in screening our positions and by forcing the enemy to make an early deployment Carefully screened supporting positions on the flanks which can enfilade the approaching enemy with a surprise fire, are of great value.

In the distribution of the force in a defensive position there are two elements of the force to be considered. The first is the firing line in the trenches, with its supports and local reserves in the cover trenches The second is the general reserve held in readiness at some favorable point behind the line The general reserve is the force with which the commander intends to turn the tide of battle and to assume the offensive when the opportune time arrives

The firing line must be manned according to the demands of the combat Weak points will need stronger forces while strong positions may be held with ease with a few troops The artillery should be concealed as much as possible and gun positions be constructed which offer good cover It is wise to place part of the artillery with the general reserve But when so placed with the reserve, a position in observation should be selected so that it may take its part in the combat without need of change Every available minute should be utilized to strengthen the defensive line The stronger the artificial protective features, the smaller will be the number of men required to hold it

The line of trenches need not necessarily be a continuous line On an uneven or broken ground this line would be far from a continuous or straight line. It would be rather a series of supporting points following a general line.

In preparing a defensive position the main idea should be to improve the field of fire Distances should be measured to furnish accurate ranges marks for such ranges should be established on the field and the defending troops should familiarize themselves with these marks so that they may make ready use of them

The trenches should be constructed with the view, first of all of providing the best opportunity for effective fire Secondly they should have good cover and concealment to the defenders ready means of communication for the supports and means of supply of ammunition food and water The control, if possible should be by means of the telephone

Hill tops are not ideal places for trenches It is true that they provide easy communication to the rear but they are too exposed and are very seldom found without dead spaces on their front that is, sections which cannot be swept by fire from the trenches Trenches located at the foot of the slope are easier to conceal and allow a good grazing fire over the whole foreground

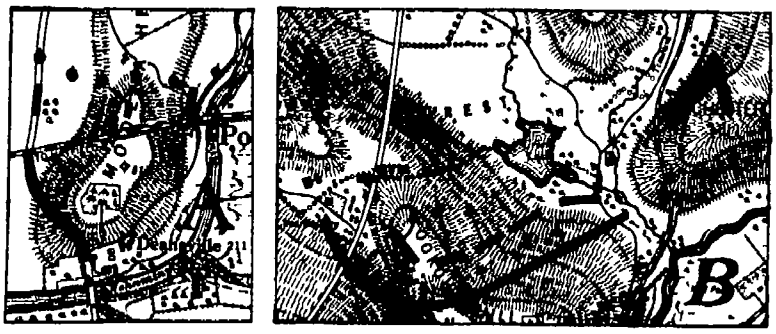
Concealed supporting trenches for surprise fire, which are not to be used until a favorable moment arrives are of great importance.

The trenches for the reserves should be deep and provided with communicating trenches for approach to the firing line

It is wise to prepare emplacements for the guns to be used when the offensive is taken up

With these considerations of the general principles of the preparation of a defensive position we can return to the Red detachment commanded by General G south of Pottstown and follow the results of his orders for taking up a defensive position

To make the situation as clear as possible, we shall go to the tower of the City Hall from which observation point a good view can be had over all the level country



Corrected diagram of situations in War Game VII, at (A) 10.30 P M. and (B) 5 40 A M.

[Owing to an error on the part of our engraver the situations depicted on page 453 of our issue of April 29th 1916 were misplaced on the map The correct positions are here given.—Ed]

A Defensive Position in the Making as Reported by an Eye Witness

"I reached the highest window in the tower of the City Hall at Pottstown at 4 00 P M. The country to the south and southeast was spread out before us as flat as a map It was as peaceful and calm as a summer day But suddenly it changed and unusual activities were in evidence Many small bodies of troops moved eastward, their starting point seeming to be the small wooded section on the road south of the railway crossing On the main road to Norrisville, a troop of cavalry trotted along while another emerged from the eastern section of the town. The advance guard and some patrols preceded this last troop across the fields and soon overtook the antlike infantry patrols

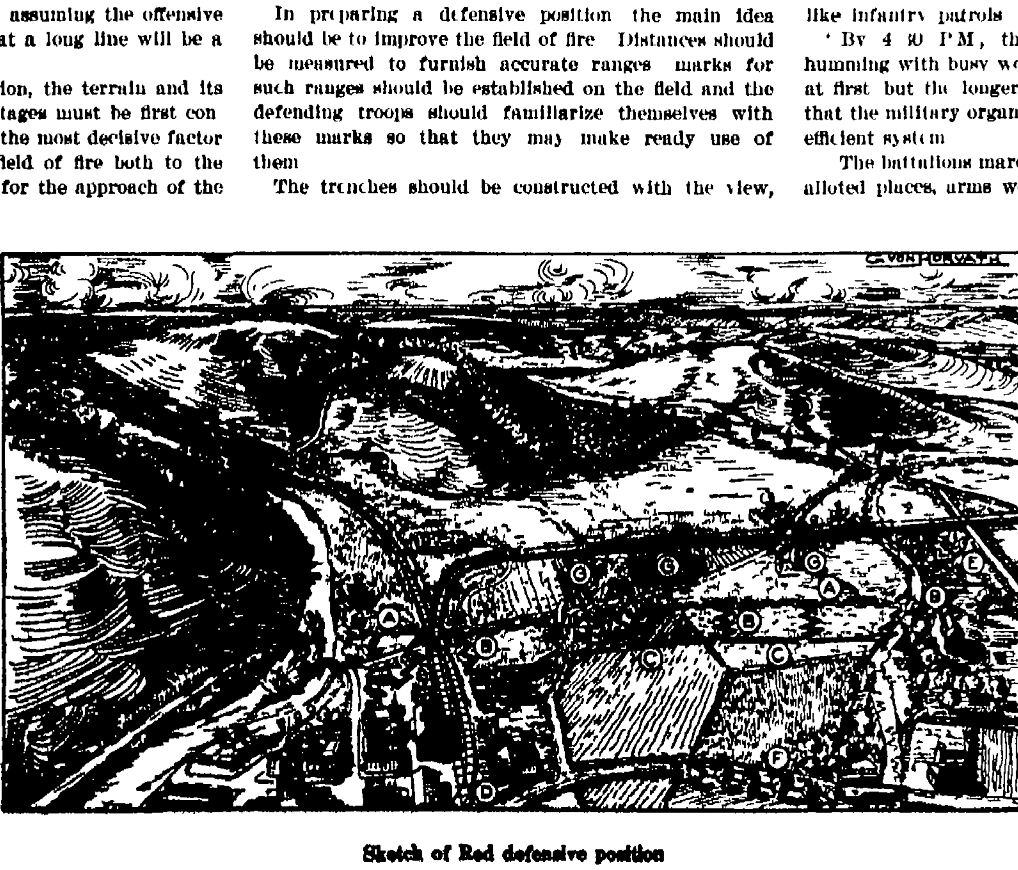
"By 4 30 P M, the whole southern section was humming with busy workmen Everything was chaotic at first but the longer I watched, the more I realized that the military organization was working with a most efficient system

The battalions marched out and were halted at their alloted places, arms were stacked and equipment was placed on the ground. Then spades and picks were brought out. Officers on horseback and on foot were busy taking measurements, pointing hither and thither and giving directions Then, as the realization came to me I saw that these troops were constructing a long ditch which stretched from the Neshaminy Bridge to the Creek Even south of the Creek, around the Manor House some soldiers were working

The artillery, numbering eight or nine guns rode out to Ash Inn and the artillerymen began to dig under the shade trees behind the Inn

"A movement attracted my eye and for the first time I saw some engineers at work near the first bridge that crossed Conestoga Creek just above the swampy

(Concluded on page 515)



Sketch of Red defensive position

A—Firing trenches. B—Communicating trenches C—Cover trenches, for supports. D—General reserve E—Trenches for flank protection. F—Artillery positions. G—Advanced trenches.

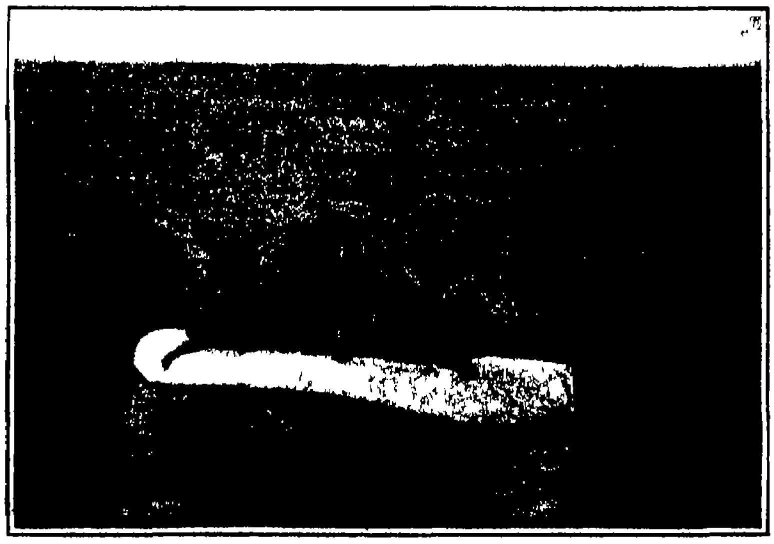
A Survivor's Impressions of the "Sussex" Disaster and Observations in London and Petrograd

By Edward H Huxley

We commend to the careful attention of our readers the following impressions of a survivor of the "Sussex" and his personal impressions of the situation in Europe Mr Huxley's long business experience and his position as President of the United States Rubber Export Company which have brought him into close touch with leading men in the commercial life of Europe, lend special authority to this illuminating article —Editor.

The journey which was interrupted by the torpedoing of the "Sussex" was commenced in January and was intended to be of not more than six to eight weeks' duration, including visits to England France, Spain and Portugal It was later extended to include Russia and the developments which occurred soon after my arrival in London caused me to take the Russian trip first postponing the trip to the western continental countries until later The trip to Russia which was thought to present greater danger than the balance of the trip, was without especial incident Few ships were in sight at any time in the passage of the North Sea from Newcastle to Bergen and no war ships From Bergen the journey continued via Christiania and Stockholm to Petrograd all by rail the only entrance to Russia now available from the west being from the Swedish frontier town of Haparanda to the Finnish frontier town of Tornio both located at the extreme north end of the Gulf of Bothnia, thence south and southeast through Finland to Petrograd At Haparanda the entrance into Finland we were from early morning until after seven o'clock at night undergoing the various examinations All luggage and each passport were rigidly examined both by the customs officials and by the military authorities

There is a more or less noticeable difference between conditions at London and those at Petrograd Aside from the darkness of the city of London at night there is little evidence of an abnormal condition other than the great number of officers and soldiers in uniform constantly in evidence Business in the City appears to go on about as usual, and the streets are crowded with pedestrians and vehicles At night the theaters are well patronized as are the restaurants and cafés and everyone seems cheerful and happy The great number of officers in the restaurants, cafés and theaters at night is easily and legitimately accounted for as they are all officers from the front on two to four days' leave, and are entitled to all the pleasure that they can crowd into that time One seldom sees the same face twice In Petrograd while some of the theaters are open the life in the restaurants and cafés is greatly changed, they must close not later than 11 o'clock and are usually not more than half or a third full, and there appears to be a complete absence of gay social life Prohibition of wine and spirits is as complete as it ever can be, and there is a spirit of dogged earnestness which is especially noticeable to those who have visited Russia in peace times and seen the completeness with which the Russian gives himself over to pursuits of pleasure. The River Neva frozen over and deeply covered with snow has been transformed into a battlefield, with snow forts and trenches, and recruits are constantly being drilled, preparatory to leaving for the front, most of the open squares of the city are also filled with troops at some time during the day, all being carefully prepared to fight. They are splendid, stalwart specimens and well equipped The most serious problem in Russia to-day is that of transportation The Government and the business men are sadly in need of material of all kinds but it is difficult and at times impossible to transport the goods The day I departed was the first day for a month that there had been passenger traffic between Moscow and Petrograd the lines being wholly given over to the transportation of freight Archangel is in an indescribable condition freight is stacked up for miles, with little prospect of relief, and the railroad is congested beyond anything that we can conceive from experience in America It is hoped that the new port of Kola will afford some relief but it will be some time before this is available There is no direct rail road from Archangel to Petrograd freight passing south until it joins the trans-Siberian railroad at Vologda whence it goes westward to Petrograd The Government is working actively to relieve these conditions but until entrance can be obtained from the south there must always be a more or less unsatisfactory condition There is a great shortage of coal, and one of the largest industrial concerns the Russian American Rubber Co, is burning daily the product of over four acres of timberland all of the trees being of full growth Prices are somewhat, but not materially, higher than in normal times



Courtesy of Illustrated London News

Survivors on the bottom of an overturned lifeboat

The sentiment in Sweden, particularly in Stockholm among the business men, appears to be undergoing a change. Early in the year there was scarcely anyone who was not confident of the ultimate success of the German arms The campaign at Verdun, in conjunction with the general trend of events since the first of the year, has seemed to shake the faith of Sweden in Germany, and a feeling is manifesting itself that perhaps after all German organization may not be impregnable. The sentiment in Sweden, however, must always be considered in the light of the hereditary enmity between Russia and Sweden existing for hundreds of years. Sweden, it should be said, is profiting greatly commercially by the sale of its products to Germany, but is rigidly maintaining its prohibition of export of many lines of goods.

The return to England was accompanied by the same vexatious delays, as travel in England itself nowadays is surrounded by more difficulties and formalities than was ever the case in Russia in peace times. The exit from and entrance into England may only be effected after rigid examination and the compliance with many formalities Somewhat more shipping was observed on the return trip, including more war vessels, one of which was a British submarine, seen just at the entrance to Newcastle harbor Once the formalities are passed, however, traveling in England is more expeditious than in other countries. The same dogged determination that one would expect and that one observes in Petrograd is present in England, and there is no thought but of ultimate victory, and all plans are being laid to that end While total prohibition of spirits does not yet exist, there is the most rigid curtailment of the consumption of spirits and only from 12 to 2 and from 6 30 to 9 may purchases of wine and spirits be made, and even then they must be consumed within half an hour after the time of closing and all restaurants must be closed at midnight.

The departure from London for the cross-channel trip was on Friday, the 24th of March, at 9 30 A.M, from Charing Cross Station The time of departure is changed with each trip, there being three crossings per week, and the train on the previous Wednesday had departed at 8 o'clock at night The time of departure may be ascertained only by personal application at the station, the object, of course being to render the time of actual crossing unknown and different each time The formalities at Folkestone being finished, the ship was boarded and proceeded on schedule, at 1 30 P M, out of the harbor passing a troop transport crowded with Tommies, who exchanged cheers with us as we went by The day was delightful, sunny, warm and with a smooth sea All went well for an hour and a half, until 3 o'clock. The vessel passed an enormous number of ships of all kinds, either steaming or anchored, and this rendered all the more conspicuous the total absence of shipping later, when we most needed assistance The explosion occurred without warning of any kind, at 3 o'clock in the afternoon, and was of such a violent nature as to completely destroy and carry away the entire forward third of the ship, and it seemed that the remainder must soon sink and disappear There were six lifeboats only. The first boat to be filled and lowered was overturned immediately upon reaching the water, and most of the occupants were drowned, a few only out of possibly twenty-five or thirty climbing on top of the overturned boat. The second and third got away safely with their full quota, possibly thirty, of

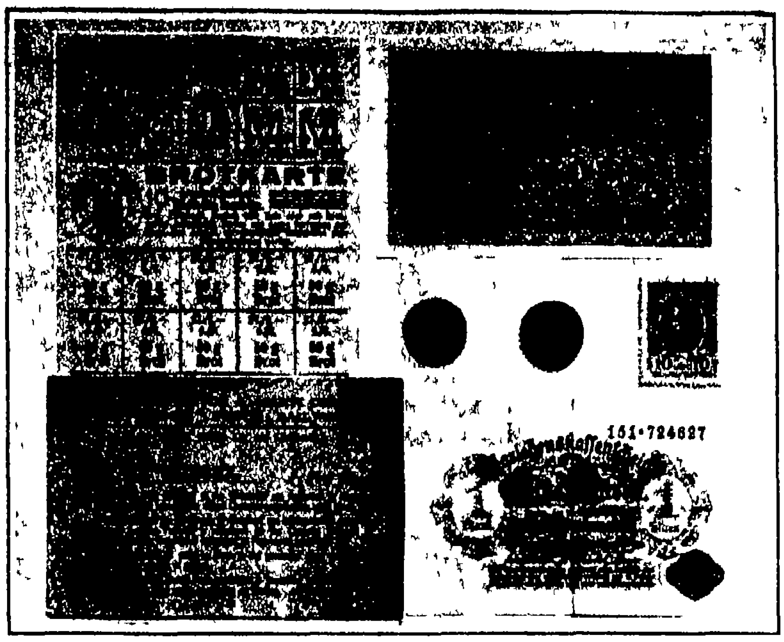
Courtesy of Illustrated London News

The "Sussex" on the beach at Boulogne

which a good portion were women. The fourth proved unseaworthy and was abandoned. The fifth got away with only five or six men in her, and the sixth again went off well loaded All of the boats leaked and required constant bailing.

After all the boats had gone it remained for the rest of us who were still on board the hulk to determine what should be done. As the ship, even though so grievously damaged, had not immediately sunk, it appeared to me improbable that she would sink suddenly, and that she might indeed remain afloat I watched a spot on the outside of the ship near the water carefully for ten minutes and found that there was no evidence of settling I assumed, therefore that immediate action was not necessary and that sufficient warning would appear to give opportunity of swimming for it if that became necessary In company with two or three other Americans who had been uninjured, we all gave our attention to those who most needed it, and, unfortunately, there were only too many We worked for some time in the wreckage in the forward part of the boat and succeeded in digging out five grievously wounded men and two women These we made as comfortable as might be, although the fact that there was no medical man among the passengers and that we could find no medical stores made the work of relief somewhat difficult and inadequate The decks were covered with water and debris as a result of the explosion and all of the wounded forward had to be handled with great difficulty and, unfortunately with little regard for their comfort The principal thing was to get them on to the deck and to wrap them up so they might be warm After an hour a more or less official examination of the ship having taken place it was announced that the danger of sinking was remote and the three lifeboats were recalled and the passengers again taken on board, this unfortunately being again accompanied by some loss of life It would appear that many of the officers and most of the crew of the ship were destroyed in the explosion and the bulk of the work of rescue was done by the passengers At no time did I see an officer of the ship directing the work Had it been realized at first that the after part of the vessel would continue to float, the most serious

(Concluded on page 514)



Souvenirs of the Great War

A Berlin bread card (Brotkarte) A Sussex ticket that was never given up on landing Russian 50 kopek paper money Obverse and reverse of a German 5 pfennig iron coin Russian postage stamp, with notification printed on back making it legal tender A German paper mark

The volunteer Patrol Squadron running in the teeth of a snowstorm

The Patrol Squadron

Privately Owned Motor Boats Pledged to National Defense

IN our issue of January 1, 1916, we showed a sketch of the proposed boats of the first Volunteer Patrol Squadron Since that time five of these boats have been placed in commission, and in both speed and seaworthiness they have more than come up to the requirements decided upon by their owners when the question of design was submitted to Mr A. Loring Swasey, a well known Boston naval architect, who designed these boats

On May 1st Secretary Daniels issued a circular letter addressed to the owners of yachts and motor boats, in which he states that the Navy Department is desirous of mobilizing for the purposes of defense the privately-owned yachts and motor boats of this country which, in construction and speed, would fulfill the requirements of patrol service.

The Secretary further states that it would be highly desirable to have a large fleet of motor boats, similar in design, which, in case of necessity, could be immediately employed for patrol service This announcement of the Navy Department's policy towards motor boats was anticipated by a number of public-spirited men, who decided to inaugurate a movement for the defense of this country against hostile attack, and they decided to build several boats of one design which could be employed as patrol boats in case of necessity Accordingly a movement was started and an organization formed, which is known as the Patrol Squadron, and a fleet of five boats was built as a nucleus, as well as for the purpose of demonstrating the usefulness of boats of this character

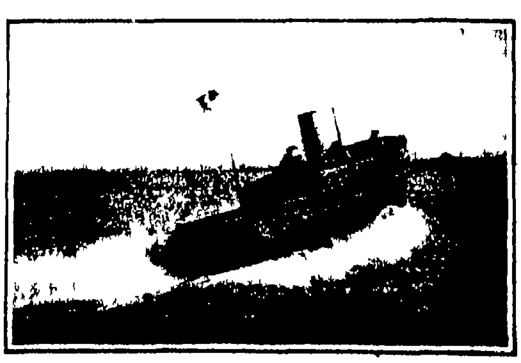
On Friday, April 28, 1916, Assistant Secretary of the Navy, Franklin D Roosevelt, who has been the father and moving spirit of this project, inspected the Patrol Squadron in Boston harbor, and was extremely pleased at the speed of the boats and the way in which they could be maneuvered while running at full speed The boats themselves are primarily adapted for use in connection with the patrolling of the coast and harbors to prevent hostile attack by submarines, as well as in assisting their own submarines, acting as dispatch boats and patrolling mine fields. Each boat is approximately 40 feet over all, with an 8 foot 0 inch beam and a 30 inch draft. They are equipped with 135 h p. engines which give them a speed, approximately, of 27 miles per hour Their owners have had them so constructed that in case of necessity a larger engine can be installed, so that a speed of over 30 miles per hour can be attained. These boats have been tried out in a heavy sea, and they were found to be very seaworthy Each boat is equipped with wireless having a sending radius of about 100 miles, and each one will mount a one-pounder rapid fire gun for offensive work against submarines. The boats themselves have ample room for the accommodation of a crew of four men in time of peace and six men in time of war At the present time each boat has a crew consisting of a lieutenant, two signalmen one being a wireless expert, and an engineer

The commander of the Squadron is Mr Stuart Davis of Southampton L I and in addition there is a Squadron Quartermaster a Squadron Surgeon and a Supervising Engineer

There will be a practice cruise in June, and from September 5th to 12th the Squadron expects to join in maneuvers under war conditions in conjunction with the battleships and other vessels which have been assigned by the Navy Department to constitute the training fleet It should be mentioned that these staunch little craft will have a cruising radius of several hundred miles without refilling their fuel tanks Furthermore, the plans and specifications of these boats were submitted to the Bureau of Construction and Repair and were approved and indorsed by the Bureau They are similar it will be noted to the patrol boats which are doing such excellent service in European waters

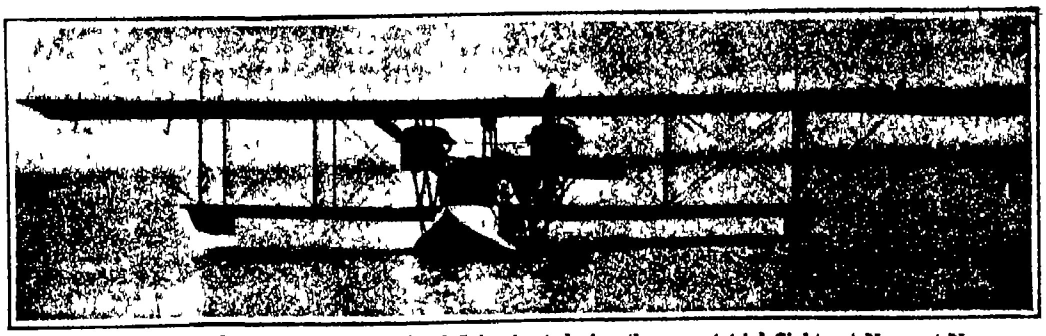
Part of the flotilla tied up at the dock

Running at 27 miles per hour



Banking on a sharp turn

The Trend of American Aeronautics Toward Giant Aircraft



Front view of the Curtiss "Super-America" flying-boat during the recent trial flights at Newport News, in which eight passengers were carried with ease

PREVIOUS to the war American builders of air craft, despite their small numbers and the lack of encouragement both from the Government and the general public, had set a new mark in the form of the "America," the flying boat with which the transatlantic flight was to be undertaken had Europe remained at peace. But the "America" was a unique instance, otherwise, the Americans left to their European confreres the task of developing the multiple-engined aeroplane of large proportions.

Since the war, however, the necessary impetus has been given the American aeronautical industry. The demand of the fighting countries for larger and more powerful aeroplanes and hydro-aeroplanes has been heard and answered not only in Europe but in America as well. The result has naturally been the appearance of a number of successful machines of great power, size and lifting capacity.

The first of the giant flying boats built by Curtiss and known as the "Super America" received its initial test at New port News on April 24th. Two flights were made with the machine carrying eight persons.

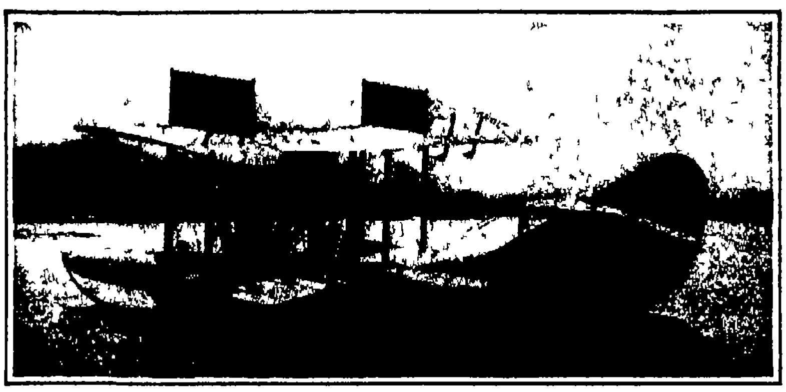
As might be supposed from its name, the "Super America" type closely follows the lines of the first "America" which was developed two years ago. The body of the present type is nearly 40 feet over all. The upper wings have a spread of 80 feet, and two 100-horse power engines each weighing about 500 pounds propel the machine through the air at a speed of about 90 miles per hour. The pilot sits in the rear, well in back of the wings, the passengers on the other hand, sit in a cockpit well up towards the front of the boat body. Because of the large surface which the fuselage offers to side winds and gusts it will be noted in the accompanying illustrations that two small vertical wings or fins have been placed on the upper wing ostensibly to prevent side drifting. The sturdy construction of the entire machine is to be admired and commended, one conspicuous instance is found in the method of mounting the stabilizing planes on stout outriggers. The hydroplane member of the craft is V shaped and provided with side fins to facilitate leaving the surface of the water. It is estimated that the useful load that can be carried by the "Super America" flying boat is 2 800 to 3 000 pounds.

The craft tested at Newport News was held out of a consignment for the British government and presented to the Coast Guard with the personal compliments of the designer and manufacturer, Glenn H Curtiss. It is reported that the present plans of the Coast Guard are to install a powerful wireless set on the craft with a view to using it as a patrol in seeking and reporting derelicts by radio. It is believed that the flying boat will be either able to destroy the wrecks or stand by even on a rough sea while summoning assistance.

Turning our attention from the water to the land, it is learned that a large and powerful aeroplane has recently been tested at Sunnyvale, Calif, under the pilotage of Roy Francis. The spread of the upper wing is 72 feet, while the over all length of the machine is 40 feet. The machine, which weighs about two tons and is propelled by two 120 horse-power engines, can carry nine or ten passengers.

The new aeroplane presents many novelties in construction according to the accompanying illustrations. Perhaps the foremost of these is the peculiar method of mounting the twin engines. Instead of incorporating the engines into the structure of the aircraft, as is usually the practice, the builder of the present machine has placed them well in front of the planes, on a sort of bracket construction. In the absence of details concerning the tests and in view of the fact that the machine has not yet been tried out in actual service, it would be little short of speculation to criticise the mounting of the engines, which appears to be unsatisfactory as judged by present aeronautic practice. The ailerons are also of a novel design in that they are of the biplane type which recalls to mind those used on pioneer machines. Taken as a whole, the aircraft does not appear to possess the sturdiness that would be expected in a machine of such ambitious proportions.

The successes attending the use of the new aeroplane in actual service will be followed with great interest. The craft is intended as a battle cruiser for the Army, it is stated, and has been inspected by Government officers. It is to be shipped to San Diego, Calif., in the near future.



Curtiss flying-boat of the "Super-America" type, presented to the Coast Guard by the well-known American aircraft builder

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The twin engines of the huge battle cruiser, showing the peculiar bracket mounting of the power plants

Current Supplement

THE *Sun Temple in Mesa Verde Park*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2106, for May 18th, describes and illustrates some recently discovered ruins of the ancient cliff dwellers that dates possibly back to 1300 A.D., and discusses the possible purpose of this structure, which is being restored by the Government. The valuable lectures by Sir J J Thomson on *Radiations from Atoms and Electrons* are continued in this issue. *Ancient Mesopotamia* tells something of the ancient history of the region about Bagdad, and the system of irrigation canals that once made this country one of great fertility and riches. It is accompanied by a map. *The Dandelion* tells of a plant for a long time regarded almost as a weed, but which is now being regularly cultivated both for its tops and its roots, which have a medicinal value. The article is illustrated. *Food Economics* considers the question of human sustenance as suggested by war time conditions. In *The Future of Ship Propulsion* a comparison is made of various systems of power and the arrangements of propellers. The article on *Great Electro Magnets* is concluded. Other interesting matter includes *Shoal Water Corals*, *Notes on Plant Chemistry*, *Aeroplane Stability*, *Transparency of the Atmosphere in Central Australia*, and a number of shorter articles.

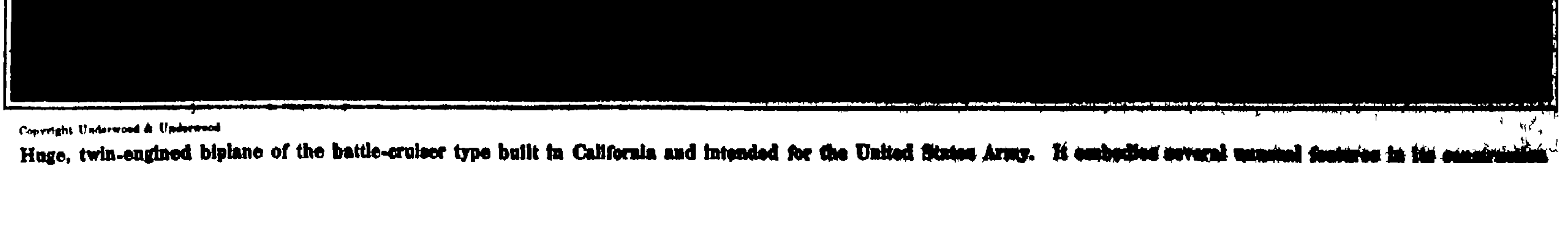
The Tractor with Drive Wheel in the Furrow

IN our issue of April 3, 1915, we published an article on the small farm tractor, in which the following statement appears: "In the design of one tractor the drive wheel runs in the furrow and, undoubtedly, creates a hard pan similar to the share hard pan formed by one horse's feet and the plow share." It now appears that the Bull Tractor Company, of Minneapolis, Minn., was at that time the only company manufacturing a tractor of this design, and that it emphasized this exclusive feature.

This company has filed with us the originals of a large number of voluntary testimonial letters and copies of several hundred letters from owners of its tractors that came in reply to an investigation following our publication of the above quoted statement. They offer overwhelming evidence that the Bull wheel running in the furrow does not pack the ground, but quite the contrary, as the wheel, being equipped with long spade lugs from 3½ to 5 inches in length, acts as a subsoiler—in fact many owners of these tractors state that they have dispensed with their subsoiling device.

After reading this evidence, we are convinced that the author of our article was in error in making the statement referred to, and we are pleased to take this opportunity of correcting the false impression that may have been created by it.

It always has been and always will be the policy of the SCIENTIFIC AMERICAN to give a square deal, and if an unintentional wrong has been done, we are pleased to correct it.



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Huge, twin-engined biplane of the battle-cruiser type built in California and intended for the United States Army. It embodies several unusual features in its construction

Inventions New and Interesting

Simple Patent Law; Patent Office News, Notes on Trademarks

How Machinery is Replacing the Human Element in Book Binding

By G T Carlisle

WHAT would our grandfathers think if they could witness 60 complete copies of a 1,000-page magazine, the signatures or sections collated in the proper positions and wire stitched, the cover glued on, and all stacked ready for bundling, turned out every minute? Yet the sight is a common one in the modern periodical and catalogue bindery, where machines known as gatherers are doing much towards reducing still further the human element in the manufacture of printed matter

A representative gathering machine is 65 feet long, weighs 16,570 pounds, and is built to accommodate pages of printed matter ranging 7 by 10, 9 by 12, and 10 by 14 inches, and for any number of sections, which are known in the parlance of the trade as "signatures" or "forms," desired. Forty feet of the machine's total length is devoted to the actual gathering of the signatures Thirty six compartments are provided for extra large magazines or catalogues

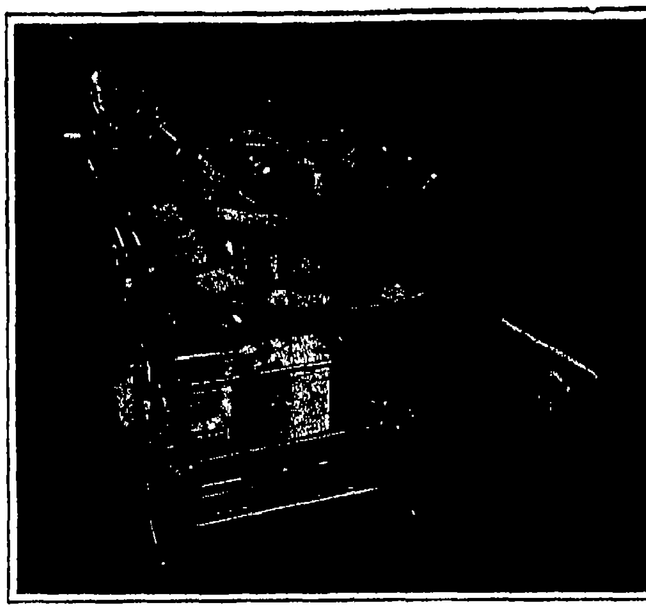
Magazines, pamphlets, catalogues, and books can be gathered, glued and wire stitched on the gatherer, and the number of girls required to feed the signatures is governed by the number of signatures or forms of the books being bound The signatures are stacked in the compartments and can be replenished by placing a further supply on top of the stack without stopping the machine In the gatherer that was examined by the author some four eight, sixteen and thirty two page forms, together with single sheets of colored plates, were being bound up

One girl is required to feed every six compartments with the proper signatures, also a male operator and one assistant for the entire machine Sometimes the girl feeder places the wrong signatures in a compartment, but where the human being is liable to error the mechanism of the gatherer is not, for at the moment the incorrect signatures reach the handlike members or grippers, the machine instantly stops A line of 36 of these grippers extends over the 40 feet of the gathering end of the machine, one gripper facing each signature compartment, and these same grippers can be used for any sized signatures by adjusting the fingers at their free end So fine is the adjustment of these fingers that an extra sheet of tissue paper will stop the entire 65 feet of machinery The delicate adjustment is effected by the centering of a piece of hardened steel passing through a measured space If the signature grasped is of the correct size to conform to the original setting, all is well but if the signature deviates even to the slightest extent from the setting of the grippers, the hardened steel piece is raised and hits a throw off arrangement which in turn throws out the main driving clutch and releases a powerful friction brake. As soon as the correct signatures are placed in the section at fault, the machine can be instantly restarted

A suction pump operated by the machine forms part of the equipment It is provided with branches that connect with each signature compartment At the proper moment the suction pipe at each compartment sucks into convenient position the bottom signature as the humanlike grippers draw the correct signatures from the various compartments and deposit them in a steel trough running parallel to them. Along the bottom of the trough moves a conveyor, which is timed to receive the various signatures at the proper period so as to insure the pages running concurrently

As the complete set of signatures reach the end of the trough, they are gripped and turned on their backs, the long way down, and enter a sleeve which squares or jogs them so that they will be ready to receive the wire stitches which are to bind them together The wire stitching mechanism is a delicate piece of machinery. Steel wire is drawn from a large reel and fed through a stapling machine, which is firmly gripped in a vise operated by two eccentrics. The wire, which has been shaped into staples, is forced through the book and clinched by a small die on the opposite side, all in the fraction of [illegible]

The book, which is now assembled but still lacks a cover, continues on its journey, arriving at an electrically heated pot of elastic glue. Fixed in the center of the glue pot is a brass wheel knurled on its outer



End view of a gathering and covering machine which automatically gathers the forms, binds and covers them to form a complete book or periodical

circumference and revolving in the opposite direction to that in which the book is traveling the wheel is mounted just high enough to impart a thin but uniform coat of hot glue on the back edge of the forms The book is now ready to enter that part of the equipment known as the covering machine

The covering machine is oval shaped and is supplied with a number of arms that seize the books and keep their leaves closed and in an erect position ready to receive the cover that is being automatically fed from a large pile at the extreme opposite end to the gathering mechanism The covers are drawn from the bottom of the pile and conveyed in very much the same way as the signatures in the gatherer on a steel conveyor and timed to reach the under side of each book the moment the latter has received its coating of glue If through any fault of the mechanism the cover for the book has not been brought into position the gluing wheel remains depressed and allows the book to pass over without glue thereby saving the book and keeping the track clean and in condition to continue operation The uncovered book can later be returned to the track ahead of the gluing wheel When the cover is in position a small die operated like a steam hammer but only working from underneath gives the cover a smart tap which presses it firmly in place At the same instant the arms of the oval shaped covering machine pick up the overlapping leaves of the cover and carry the book to the final outlet of this wonderful mechanism The completed books are deposited in a neat pile ready for bundling and subsequent distribution

The covering machine does not necessarily have to be operated in conjunction with the gatherer proper If desired, a hopper can be used to supply many and various sized books to be covered The books in some instances may be gathered by hand yet so remarkable is the versatility of the mechanism that covers are readily applied to them The covering machine can also be employed in binding books without staples, so that they will open out flat

A reproducing lathe in which a piece of wood is properly formed to correspond with a plaster cast

Scene in an American artificial limb work-shop in England, showing how the limbs are fitted to the wearers

Manufacturing American Artificial Limbs in England

By G R. Thomas

PREVIOUS to 1914 the demand for artificial limbs in England was small in comparison to the consumption in this country This was no doubt due to the better protection for life and limb provided on the railroads and in the various manufacturing and mining industries For these reasons the development of this interesting and humane art was rather neglected and such firms as did manufacture artificial limbs did so as a part of a general surgical supply business Meanwhile America produced a number of firms which have specialized on these articles and have developed them to the highest point of perfection and today American artificial limbs are acknowledged to be far superior to all others

When the present great conflict in Europe began to get well under way and the casualty lists mounted higher and higher the British government formulated a plan for immediately taking care of the large number of men who had lost arms and legs in battle, instead of waiting until peace was declared To accomplish this result convalescent hospitals were established in Roehampton House, Roehampton a suburb of London loaned by Captain Wilson and in Dover House an adjoining estate loaned by Mr J P Morgan of New York

The foregoing mentioned hospitals are supported partly by the government and partly by private contributions They are complete in every detail The best medical attention is supplied and every convenience contributing to the comfort and entertainment of the men is provided All sorts of amusements are indulged in and schools have been established for the purpose of training the men to become useful members of the community instead of objects of charity as has so often been the case in the past They are taught stenography bookkeeping and other light occupations which adapt themselves readily to their conditions, and an employment bureau finds positions for the men when they are discharged

As soon as a man is able to be moved from the base hospital at the front he

is brought to one of these convalescent hospitals and kept there until he is provided with an artificial leg or arm, as the case may be, and is then either discharged from service with a pension, or put into clerical or other light work for the War Office

To supply the necessary limbs, work shops have been erected in the hospital grounds and each limb is made and fitted under the personal supervision of the authorities

Naturally the English manufacturers were soon swamped by the unprecedented demand and after careful investigation several American firms were invited to demonstrate their products At the conclusion of the investigation, work shops were erected for several American firms and these are now supplying a large portion of the limbs.

The improvised work shops are carefully constructed one-story structures and are completely equipped with specially designed machinery, tools, power and other requisites. They comprise comfortable measuring and fitting rooms and large convenient wood working and finishing shops The limbs are usually made in a rough state in all sizes and shapes in the American shops and in this condition are known as "setups. Large stocks of these setups are kept in London and they are constantly being shipped from America After a man has been measured a setup is selected and this is finished up to fit him.

The fitting is accomplished in several ways by different manufacturers. The usual procedure is to take a plaster cast of the stump or point of amputation and to shape the socket of a leg or arm to correspond with this cast In some instances this is done by hand with the use of draw knives while in other instances it is accomplished with the use of a reproducing lathe The latter is an interesting and novel machine which receives a block of wood in one basket or holder and the plaster cast in another A roller coming in contact with the cast controls the lateral movement of a cutter mounted on a spindle, which reproduces the exact shape of the cast in the wood in an absolutely accurate manner This fitting of the stump into the socket is the most important phase in the making of an artificial limb for unless the fit is absolutely right, no matter how good the rest of the construction is, a man will be unable to wear the limb and it will be useless It follows that the utmost care is necessary in this operation and the greatest skill and judgment must be exercised

After the socket is completed, the rest of the leg is shaped up and adjusted to the proper length It is then covered with rawhide and enameled or varnished as required

Not the least important part of the manufacture of artificial limbs is the selection of the wood used This must be light and very tough, and of good straight grain High willow and second growth hickory are mostly used and they must be thoroughly seasoned Large tracts of forest lands have been purchased and gangs of men are busy cutting and seasoning the timber

Most of the work is done in these factories by Americans who have been sent over for the purpose. This labor is of a very high class and good wages are paid Great skill is essential and it requires years of experience for a man to become really proficient in this art. One interesting feature of the labor question is that most of the men engaged are minus a limb themselves, and these men make the best workmen, for in studying their misfortune they have come to appreciate the other fellow's trouble and give him the benefit of their personal experience

Super-Zeppelins

(Concluded from page 508)

ten tons more than the vessels of the previous type Some weight may also have been saved through an improved system of construction, as well as by the new 200-horse power engines which weigh only 880 pounds, instead of 985 pounds.

On the basis of the above ratio a 33-ton super Zeppelin carries a useful load of about $11\frac{1}{2}$ tons—more than double the load the previous type was capable of lifting If such is the case, allowance for two tons of ammunition leaves nine and one half tons available for crew, ballast and fuel

The Crew.—Of the two super-Zeppelins destroyed lately, the LZ-77 carried 15 men and the L-15 whose crew was captured, two officers and 16 men Supposing the latter figure represents the war complement of the largest super Zeppelin, it remains to be computed how these 18 men are detailed for navigating and fighting

The three engined passenger Zeppelins required a navigating personnel of nine men distributed as follows the commander, two helmsmen and two mechanics in the front car (housing one engine), and a chief engineer and three mechanics in the rear car (housing two engines)

Although a super Zeppelin mounts a third engine astern, it might be assumed that the engine crew has not been increased, five mechanics and one engineer being quite sufficient for looking after four engines But in view of the super Zeppelin's long cruising radius a third helmsman might have been added to the crew, this would leave eight men, including the lieutenant, for manning the bomb tube and the machine guns Six men are required for manning the latter, the remaining two would then constitute the bomb-crew with the lieutenant as gunnery officer, and possibly, second in charge of navigation

A complement of 18 officers and men represents a load of about one and one half tons, there would then remain eight tons for ballast and fuel

The Ballast.—There are very good reasons for believing that the water ballast has been considerably increased on the 33-ton airships Vessels of the previous (23 ton) type, which carried $1\frac{1}{2}$ tons of ballast, used to navigate at an altitude of 5,000 feet and hardly ever reached the 9,000 feet mark, excepting trials, super Zeppelins, however, often reach an altitude of 10,000 feet and are currently seen navigating at 7,000 feet

Whereas the buoyancy of a Zeppelin is just sufficient to keep the vessel floating at a low level, great heights can be reached only through a combination of dynamic lift (expenditure of engine power) and of static lift, the latter being attained both through jettisoning ballast and burning fuel, and in extreme cases, by a forced dropping of bombs.

The question of ballast is one closely allied with that of compensating losses of buoyancy at great heights. Lack of space unfortunately forbids a detailed discussion of this subject, suffice it to say, that losses of buoyancy cannot be made up entirely by jettisoning ballast and one might assume that some artifice, possibly a system of compensating balloonets for each of the 20 or more gasbags, has been devised for remedying this defect on super Zeppelins

Such a course should not be astonishing at all in view of the several airships the German Navy lost in the North Sea, for the sole reason that when they came down from a great height the gas, after having expanded, contracted through the greater atmospheric pressure and proved insufficient for insuring the necessary buoyancy It was this phenomenon which caused the loss of L-3 and L-4, not to speak of others.

Anyhow, one can safely assume that the ballast of a 33-ton vessel is at least double that of the *ante-bellum* Zeppelin, say three tons, but more probably four tons, leaving four tons available for the fuel

Cruising Radius.—As the fuel consumption of the four-engine unit amounts to about 450 pounds per hour, four tons of fuel would keep the engines running for about 18 hours at full speed (55 knots) and thus insure a cruising radius of 990 nautical miles. The latter figure will possibly necessitate a reduction of, say 10 per cent, if allowance be made for the fuel burnt while climbing

If it were feasible to run the vessel on the homeward journey (after she has been lightened up through the expenditure of fuel, ballast and bombs), with two engines only, the radius of action might be somewhat increased By using the formula

$$\text{Speed at x Power} = \frac{\text{Full speed}}{\sqrt[3]{\dfrac{\text{Full power}}{\text{x speed}}}}$$

one finds that by running with two engines the airship would develop a speed of 38.8 knots, which means a saving of 225 pounds of fuel per hour and consequently an additional cruising radius of about 200 nautical miles (9 hours at 55 knots = 495 nautical miles + 18 hours at 38.8 knots = 698 nautical miles, total 1,193 nautical miles)

The accuracy of these figures, based on more or less plausible assumptions, cannot obviously be vouchsafed to a mile, still they seem to bear out pretty well in the light of the latest Zeppelins incursions, when some of the raiders went as far as Liverpool and Edinburgh

Here it should be noted that the raiders which attacked these places, or at least their environs, were all reported as coming from the East, *i e*, from across the North Sea and not from the South, *i. e*, from Belgium, which means that they belonged to some of the numerous "airship-harbors" which dot the German coast from Tondern (in Schleswig Holstein) to Emden, on the Dutch frontier The distances between Tondern and Edinburgh (440 nautical miles) and between Emden and Liverpool (400 nautical miles) would seem to bear out the assumed cruising radius of the super Zeppelin.

As to the reason, why these vessels should choose a long and perilous journey across the North Sea rather than proceed from Belgium, one might argue that the latter course, while incomparably shorter, has been now rendered exceedingly unpleasant to the Zeppelins through the vigilant activity of the Allies' airmen and anti aircraft guns This the casualty list of the Zeppelins proves to the best satisfaction

A Survivor's Impressions of the "Sussex" Disaster and Observations in London and Petrograd

(Concluded from page 511)

loss of life might have been prevented

The foremast having been blown away, the wireless was out of commission for the time being but was later temporarily rigged up and the operator commenced to send, and so continued Apparently our signals were not caught for some time At the time of the explosion there was not a single ship in sight, which was most unusual, and, aside from a sailing vessel which came in sight about 5 o'clock and then disappeared there was no ship in sight until the first rescue ship came alongside, at quarter past eleven There was apparently steam in one of the boilers all the time for after nightfall there were electric lights on the hulk, and as soon as dark fell rockets and bombs were continually fired as signals of distress, but for some time there was no answer As much of aid and rescue as could be done having been done before darkness, there was little to do after nightfall except to await a rescuing ship. A French patrol boat came in sight about 11 P.M and coming alongside, made fast and took off all of the women except three and most of the men leaving perhaps fifty or sixty of us still on board, including the wounded After loading to her capacity she made off, giving place to a British destroyer that made fast immediately after her departure. At that time, however, about midnight, half a dozen vessels were in sight, including two more destroyers that circled about the wreck within a diameter of half a mile to prevent further attack The destroyer put an officer and six seamen aboard the "Sussex" to direct the work of rescue. We first put the three women on the destroyer, then the wounded a most difficult and trying task, and later all of us went over and deserted the "Sussex," leaving only the dead on board. The destroyer made off at 2 o'clock and landed us all at Dover at about four.

The officers on board the destroyer were most kind and solicitous for our comfort, and everything that they had was quickly placed at our disposal. The most welcome thing, however, was the services of their surgeon in caring for the wounded, one of whom unfortunately died on the trip to Dover The chief surgeon, with whom I soon made friends, was formerly an engineer on the U. S. Battleship "Olympia" at the time she was the flagship of Admiral Dewey, and he was on her during the battle of Manila Bay. Upon arrival at Dover we were shown every courtesy, even the unusual one of being permitted to depart from a prohibited area without the usual formalities. We reached London about 10 o'clock. The cross-channel service being suspended for the time being, the trip to France was temporarily given up, as my trip having been already prolonged beyond the original plan, the two to three weeks' delay which must occur if I should go to Paris could not be thought of I therefore returned to New York upon the first available steamer, arriving by the "St. Paul" April 14th.

That the destruction of the "Sussex" was accomplished by a torpedo appears to be beyond question, quite aside from the affidavits of those who, including the captain of the ship, saw the torpedo approach. The modern torpedo, especially that used by the Germans, is more powerful than the average mine, and it is hard to conceive of a drifting mine which would accomplish damage to the extent of completely destroying and blowing off the entire forward third of a vessel of the size and weight of the "Sussex," a vessel of nearly 1,500 tons, strong and seaworthy The portion of the Channel, furthermore, where the explosion occurred is not regularly mined, and there had been no weather sufficiently rough to cause mines to break adrift Again, the British mine, upon breaking adrift, becomes inoperative. From these facts the contention that the ship was destroyed by a torpedo appears to be clear, and that it could be other than a German torpedo is inconceivable. I found a piece of the torpedo while working in the wreckage, the metal being bronze or similar alloy, whereas mines are constructed of iron or steel This again confirms the conclusion that it was a torpedo With nearly 500 souls on board and lifeboat accommodation for not to exceed 200, had the ship sunk the disaster must have inevitably been accompanied by an almost complete loss of all lives on board. Had the torpedo also struck a little further aft and blown away the bulkhead which kept the ship afloat, the destruction must have been complete, and had the sea been running high it is doubtful if the vessel in her shattered condition, could have kept afloat That she did float appears to be due to a series of circumstances and conditions, any one of which having been different would have made the outcome at least doubtful

On the following day, a tug having been sent out to search for the hulk of the "Sussex" and finding it, she was towed to the port of Boulogne and tied up, later being beached. I cannot speak too highly of the conduct of all the Americans on board. They all took an active part in the work of rescue, kept their nerve, and made me proud of being an American, and the fact that at least two were on their way to join the American Ambulance in Paris, both of whom were grievously wounded, cannot fail to justify the feeling of friendliness with which the citizens of America are held by the Allies. There should be mentioned among those working most heroically and incessantly in the work of rescue a young Frenchwoman, secretary to a French business man who was killed, and who, entirely without thought of herself, constantly labored to aid and comfort the passengers. She had lost everything and was entirely without friends and money She was ultimately taken to the home of an English business man, and later employment was found for her on the staff of an American company's office in London.

One does not have to travel far in England to observe evidences of Zeppelin raids. Going from London to Liverpool, I passed through a [illegible]

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which had been entirely destroyed, and in London itself one may find buildings either pock-marked, damaged or entirely destroyed. I happened to be in Manchester at the Midland Hotel at dinner when the raid of January 31st occurred just south of Manchester All the lights were extinguished upon news of the approach of the Zeppelins, as total darkness is the surest way to mislead the pilots. Upon news of a raid all railway traffic is stopped and lights are extinguished and this has been the means of reducing to a minimum the damage done As the Zeppelins usually approach England early in the evening there is time for warnings to be sent out and the usual precautions taken

In Stockholm I had some conversation with a prominent business man of Hamburg and from him learned at first hand something of the conditions and sentiment in Germany He in common with all others appeared to be anxious for evidences of signs of peace and he intimated that many things that Germany had insisted upon early in the war might not be insisted upon now There appeared to be in his mind and perhaps a reflection of the general sentiment of Hamburg business men, a feeling that there would be no question of indemnities on Germany's part in negotiating peace and as the statement has been made on the part of Germany many times that the cost of the war would not be upon Germany, it may be taken as significant of a lessening in confidence He said that the Zeppelin raids and the indiscriminate attack upon unarmed cities and the destruction of innocent lives was not popular in Germany and did not meet with the sanction of the better class of German business men Meat is prohibited three days out of each week, and that the German population keenly feels the pinch of war is a fact Paper money as is the case in most countries, has displaced the higher coins in Germany and fractional currency of less than a mark in value is now made from iron. The cuts appearing show one of these iron coins, in obverse and reverse, as well as a paper mark and the famous German bread card In England there is no dearth of silver and copper coinage but in Russia there is no metal coinage, the fractional currency being either small notes or postage stamps engraved for the purpose cuts of both of which are shown The spirit of optimism so apparent in England and Russia cannot help but be reassuring as to the ultimate outcome of the war especially when it is contrasted with the reports which come to me of conditions in Germany Active preparations are proceeding for another winter campaign although all hope, and many express the belief, that the coming autumn will bring the close of the war

It is inevitable that a thinking man should contemplate, after having seen at first hand what war means the condition of his own country and wonder what might have been the present situation had it not been for the preparedness of the British Navy and the French Army

War Game—IX

(Concluded from page 509)

ground. Through my field glasses I saw them clearly and at first I could not understand what they were doing. Then I remembered that the springs on Goat Hill which fed the Conestoga were very copious The engineers were evidently building a dam across the creek with the intention of inundating the swamp. In less than an hour the effects of their work were to be seen

"As I returned my gaze to the digging battalions, I marveled at the quickness with which they worked. The first line was hardly ready before they began to dig zig zag lines to connect them with the second line trenches Then I saw a group of soldiers cutting hay in the meadow Another group, having secured two wagons, disappeared in the small forest on the Norrisville road south of Ash Inn.

"At the same time officers were pacing off the ground in front and at certain spots were placing live branches as

markers and at other spots were making piles of stones. I knew that they were marking the ranges in the foreground.

"A great deal of noise of hammering and breaking of wood attracted my attention from the eastern end of the town and I decided to descend from the tower and investigate. The officers were courteous but were firm in their refusal to let me near the houses. One officer who seemed to be in command told me: 'We are preparing that edge of the town for defense and no civilians are allowed to enter.'

"Night came and I decided that at sunrise I should be in the tower again. Thanks to the aide of General G, who commands our forces, I received permission to return.

At daylight the General and a staff officer were in the tower when I arrived. My first glance at the field startled me. It seemed as if the earth had opened up and swallowed the battalions, the engineers, artillery and all. Down around Goat Hill, where the day before a swampy, green meadow stood now stretched a large lake which shimmered in the early morning sun.

But the soldiers—I discovered only a few. The hay that the soldiers had been cutting the day before and the branches that had been brought back from the forest in the tow wagons, had all been used to cover and hide the earthworks. It was difficult even to discover the zig zag lines that connected the two trenches. The artillery was perfectly screened.

Just in front of the first line trenches I discovered a fence like construction, about 80 yards from the works. These were entanglements of barbed wire.

In the cemetery was stationed a company of infantry. A few more trenches for kneeling men were in the field ahead of the main line.

The country was so quiet, the sun was so bright and warm, and the atmosphere was in general so peaceful that it was hard to believe that right here, under my very feet was *war*, ready to be let loose at any moment.

Developments and Situation of the Red Detachment

General G received the reports of his subordinate commanders at 9 00 P M on the 13th. It was reported that the entrenchment of the detachment had been completed. Based upon the reports received, General G issued the following order:

Red Detachment,
POTTSTOWN 13 June, 19—

A strong detachment of the enemy is approaching from the direction of EDEN.

We will hold the position prepared in this vicinity.

The First and Second Battalions will form the firing line.

Companies I and K of the Third Battalion, as right flank guard, will take position east of MANOR. Companies L and M will support the artillery at ASH INN.

The Fourth and Fifth Battalions will form reserve and will take position at factory south of railway station. Three guns will accompany the reserve.

The engineers will assist in strengthening the position and then join the reserve.

The First Squadron will withdraw from NORRISVILLE and await further orders at BOWERS.

Battalions will establish their own aid stations.

Dressing station will be established in the Factory Building.

Ammunition will be issued at the Railroad Station.

Field kitchens and supply details will accompany each battalion.

I shall remain at the CITY HALL.

At 9 30 A.M., on the 14th, the commander of the Red forces receives several reports from the independent cavalry that a hostile brigade with cavalry and artillery is marching towards Pottstown. At 10 30 A.M., the larger portion of the second squadron appears on the hill leading from Paoly Forest to Wister Farm. At almost the same time, rifle fire is heard *from that direction*.

Answers to Questions in War Game VIII

Question 1. He will probably gallop ahead with the cavalry regiment as soon as the regiment reaches him at Ferguson Farm. This we presume will be at 11 00 A.M. Allowing time for the advance guard, he might be on the top of Goat Hill at 11 20 or 11 30 if he is not in so great a hurry. From this point he has a splendid view of the enemy lines and can make his decision.

Question 2. At the time Brigadier Gen-

eral I G of the Blues has reached Goat Hill, the point of the advance guard will approach the two houses on the edge of Paoly Forest He sends the commander of the advance guard the following order

The enemy is entrenched south of POTTSTOWN, parallel with the railroad. Continue advance on the NORRISVILLE road to the edge of the forest. Then attack from there I shall remain on GOAT HILL.

He summons the infantry and artillery commanders by signal, and they arrive at 12 10 P M He then gives them the following orders

The enemy has occupied a defensive position in our front It is apparently a reinforced brigade

We shall break through his line at the south east corner of POTTSTOWN

First Infantry will be the firing line and will attack between ALPINE Railway and the CREEK

Second Infantry will be the reserve and will take position in the forest in the direction of the southeast corner of POTTSTOWN

The cavalry will remain here under cover as artillery support and await further orders

The artillery will take position on GOAT HILL and will fire on the enemy battery at ASH INN The second artillery position will be on HILL 50 to fire on the small woods and the enemy reserve

I shall remain here

Question 3 Brigadier General I G decides that to send the cavalry to Norrisville is not wise under the circumstances for the inundated territory serves as a good flank support for his detachment At the same time he realizes that as he intends to penetrate the enemy line he will have good use for the cavalry when the time comes

The ground is very favorable for a cavalry attack

Question 4. The order of Colonel C will be

The enemy is in POTTSTOWN and vicinity

We will march to NORRISTOWN via BERRY FARM road to envelop the enemy's right flank

Two troops of the First Squadron will constitute advance guard

I will ride at the head of the main body

The Theory of the Defense Against Enveloping Attacks, Against Double Enveloping Attack's, and Against Penetrating Attacks

The commander of the defensive forces will not know of the enemy's definite intentions until these intentions begin to show themselves on the battlefield Therefore his main duty is to watch the enemy's actions closely, both personally and by means of his staff officers, and to keep himself posted as to everything that may happen With the exercise of great vigilance, the enemy's moves may be counteracted or at least met half way

The chief instrument of the defense is an accurate and well directed fire delivered at the right point and at the right time Through this fire and the utilization of advanced positions which must be withdrawn in time not to mask the fire from the main trenches, the enemy may be forced to use up considerable of his reserves in advancing near enough to deliver an assault

During the whole combat, it is not likely that the enemy will attempt a general assault covering the whole front Such an attempt would probably prove too costly unless he has an overwhelming numerical superiority He will usually select one point against which all of his efforts will be concentrated This point might be either the flanks or some promising point on the front This then is the occasion where the superior skill of the defender must repel the attempt of the offensive forces

In most cases, the local reserves may be able to turn the tide by a well directed counter attack In such cases the counter action of the enemy will always expend more force than the attack of the defense, and will permit the placing of the bulk of the fire on the enemy reserves while deploying and exposed through the counter attack

Once the enemy has succeeded in gaining the distance which will enable him to attempt an assault, the greatest possible fire should be directed upon that portion of his forces, by both the infantry and artillery If our own artillery can deliver a more effective fire by using direct instead of indirect fire the artillery commander should immediately undertake it, even though he is exposing himself to great losses.

The general reserve, as we have stated before, should be held intact. Its mission is to assume the counter-offensive and crush the enemy when the right time

comes. To this rule of the use of the general reserve there is but one exception absolute necessity of using it otherwise.

To sum up the means of defense against the different forms of attack

Frontal attack is defeated by effective fire and counter attack

Enveloping movements are defeated by timely disposition of the reserves, by effective fire and possibly by counter-attack directed against the weakest point of the attacking enemy

Penetrating attacks are defeated by proper placing of the reserves, by fire and by counter-action

Questions

Question 1 The Blue artillery has reached the position designated by the brigade commander Place the batteries in their exact positions on the map What will be the range of the Goat Hill group, provided it fires on the enemy battery at Ash Inn?

Question 2 Place Blue Infantry in position on the map at 1·00 P M

Question 3 What will the commander of the Blue advance guard order after having reached the edge of the forest?

Question 4 The Blue skirmish line appears at the short western edge of the Paoly Forest at 12 50 P M What will happen?

Question 5. What disposition will General G make in regard to the squadron after its arrival in Pottstown?

Question 6 Give an account of the rifle fire which followed the return of the Red squadron at 10 32 A M?

Question 7 The matter of making connections with the Red division north of Nehaminy river was omitted from General G's order Is this an error?

* * * * * * *

[*The tenth War Game will deal with the entrenchment of the Blue forces and the work of trench warfare This series began with the issue of March 11th 1916 A large map in colors, of the terrain covered by the series was published in the issue of March 25th Copies of this map may be had for ten cents each* —EDITOR.]

NEW BOOKS, ETC.

WIRING HOUSES FOR THE ELECTRIC LIGHT Together With Special References To Low Voltage Systems. By Norman H Schneider New York Spon & Chamberlain, 1916. 12mo , 112 pp , illustrated.

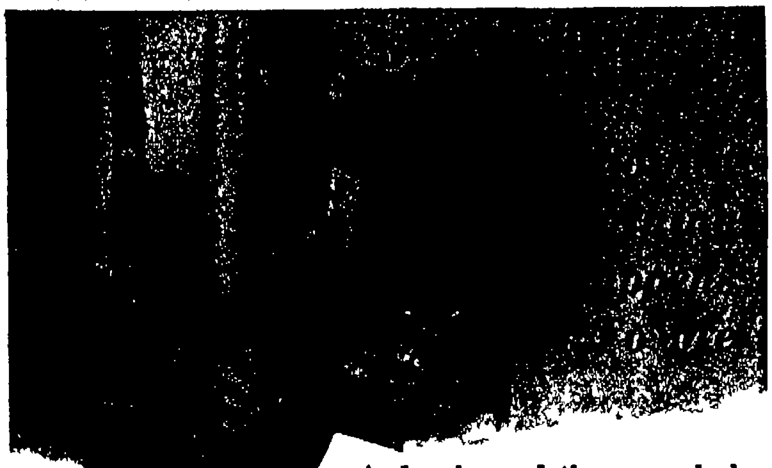
The new edition of this handbook incorporates many of the improvements that are constantly being made in the field it covers. Among the new material may be noted a section on conduit and protected wiring and some additional full page plates. Progressive instruction is furnished in planning the wiring, in completing the installation and in installing the light fixtures. Concentric wiring, a system much in use abroad and well adapted to the less pretentious dwelling, is clearly explained, and the estimating of material is an important feature that has not been overlooked.

CHANGES IN THE FOOD SUPPLY AND THEIR RELATION TO NUTRITION By Lafayette B Mendel New York Yale University Press, 1916. 12mo , 61 pp. Price, 50 cents net.

The preservative methods of to-day keep fresh fish in prime condition for two years, and allow us to draw upon China for our egg supply This essay by a well known physiological chemist is a thoughtful review of the situation in the light of history and statistics It approaches the problem of the nutrition of the masses from a physiological standpoint, and takes up reforms in diet such as have been made necessary in Germany under the conditions of the war

SUBMARINES. Their Mechanism and Operation. By Frederick A. Talbot. Philadelphia J B. Lippincott Company, 1915 8vo , 274 pp., illustrated Price, $1.25 net.

In his latest work, Mr Talbot has done for the submarine what in his earlier volume "Aeroplanes and Dirigibles," he did for aircraft he has brought broad mechanical principles and tactical operation to the understanding of the general reader, without becoming at any time tedious or obscure Of course, all the information conveyed is of a broad and somewhat superficial nature, to go deeply into the complex engineering and scientific problems involved would be to lose his audience, but all questions likely to arise in the mind of the average man are answered. There is a brief history of the under-water craft with particular reference to the Holland and Lake types, but by far the greater portion of the book is devoted to the first use of the submarine in war.



MENNEN'S
SHAVING
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SCIENTIFIC AMERICAN

SCREWING THE FUSE PLUG IN THE BASE OF A HOWITZER SHELL

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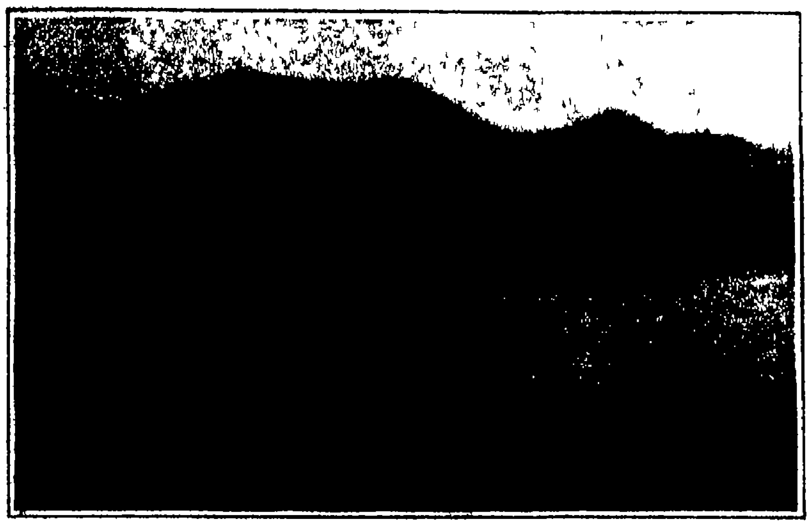
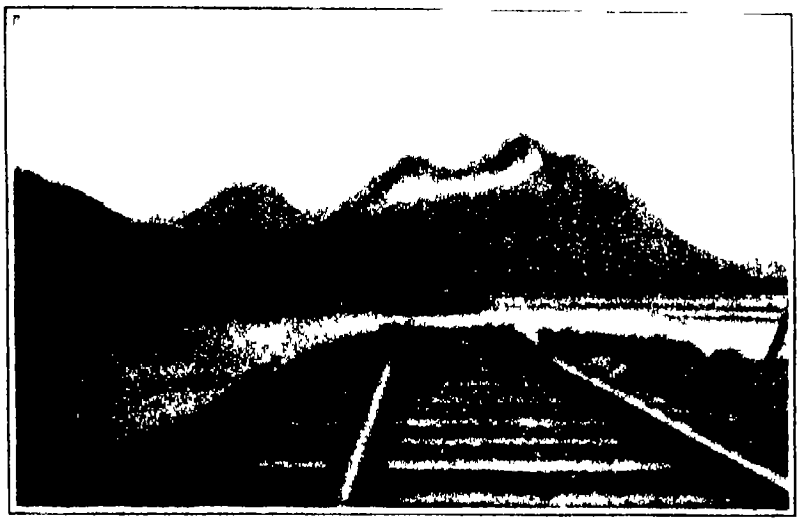


Track buckled by flow of ice underneath



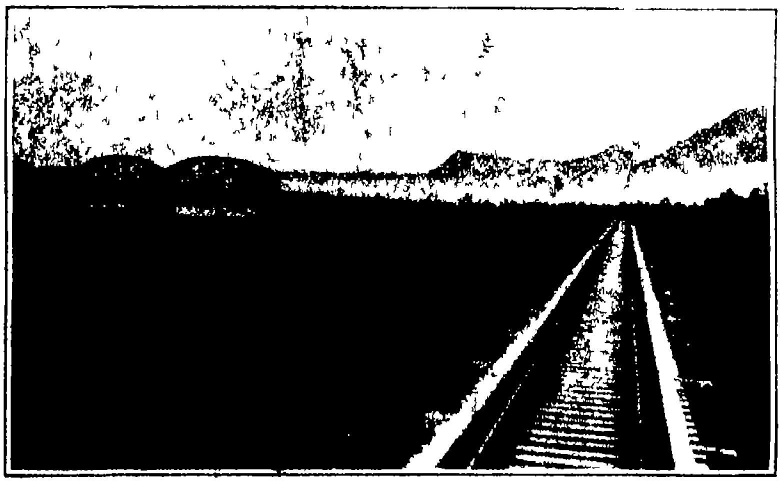
Washout at a small stream crossing

The Difficulties of Railroad Maintenance in Alaska

By Kirk McFarlin

RAILROAD construction in the United States to-day is of so thorough a nature, and operation is so systematic, that the service is seldom interrupted. Spring floods and heavy winter storms sometimes excuse a delay in traffic, but as a rule the maintaining of schedules as well as of road beds has become a matter of routine. In Alaska, however, the frontier of to-day, railway operation is more difficult than it was a quarter of a century ago in the states at home. The wild nature of the country, the severity of the climate, and the occurrence of natural phenomena not found elsewhere make construction as well as timetables very uncertain. The Copper River and Northwestern R. R., the longest of the two standard gage lines now in operation in Alaska, probably combats natural conditions more severe and peculiar than those encountered by any other railroad in the world.

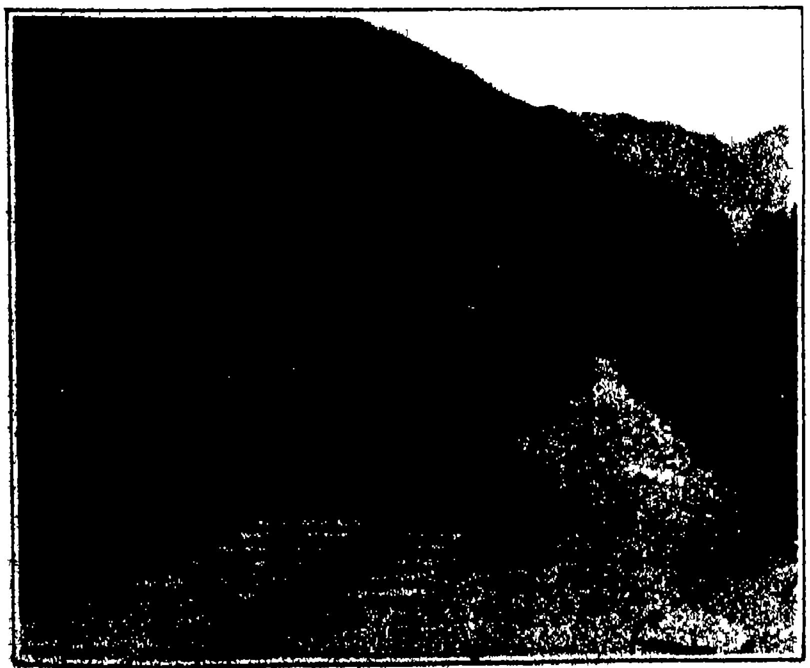
The Copper River and Northwestern connects the now well known Kennecott copper mines with the seaboard. Two hundred miles of single track line were built in the years 1908-11 at a cost of $16,000,000, an average of $80,000 per mile. The seaboard terminus, Cordova, is 1,500 miles northwest of Seattle. The line first pierces, through a very rugged gorge, the almost unbroken mountain barrier which skirts the Alaskan coastline, then penetrates to the center of the higher interior mountains. A steady rise, with limiting grades of five per cent, brings the line to a final elevation of 4,000 feet.



Copper river bridge, Childs glacier in distance

The first 40 miles of rail traverse the broad delta of the Copper River which is broken by hundreds of small glacial channels. The mountains are then reached and for the next hundred miles the line threads the gorge of the Copper River. This river, so-called from the large nuggets of native copper found along its course, has cut, through the mountains which rise above to heights of 8,000 and 10,000 feet, a box like canyon of varying width, with a flat floor of gravel, and sides perfectly sheer. At intervals along its length large glaciers projecting from the ice fields on either side spread out over the floor of the canyon, and shifting glacial streams intercept the river. The lower entrance to the canyon is flanked by the two largest glaciers, with frontal widths of 3 and 5 miles, one on either side of the river. Their ice faces towering 300 feet above the river form one of the sights of all Alaska. The Copper River bridge which spans the river between these glaciers ranks among our remarkable bridges. Its three long truss spans were built in a single winter despite arctic cold and blinding storms. Falsework and caissons were driven through 12 feet of ice, the movement of which at one time carried the last span 12 inches out of line. The final span was joined up but

(Concluded on page 737)



At Baird canyon; rails overturned by whirlpool

One of the obstructions encountered

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A National Calamity

IN view of the present crisis in the world's affairs, and quite possibly in our own, the action of the Senate in emasculating the Chamberlain bill for the reorganization of our military forces can be regarded as nothing less than a calamity, and as liable to lead in its ultimate results, to a great national disaster. The Chamberlain bill calls for a standing army of a minimum strength of 250,000 men, and for a Federal volunteer army of 261,000 men. The expert minds of the General Staff and the Army War College have given it as their opinion that a regular army of 250,000 men is the smallest thoroughly trained force upon which this country of ours can rely with confidence as the basis of its mobile defenses, and they believe that the proposed Federal volunteer army of 261,000 is an experiment which has sufficient promise to render it worthy of a serious trial. On the other hand, there is a unanimous consensus of military opinion that the "Federal militia" scheme, as proposed in the Hay bill, because of the existing constitutional limitation set upon the Federal Government's control over the militia, would prove to be a broken reed. And it does not require the trained judgment of the military expert to foresee that the proposed payment of from $40,000,000 to $50,000,000 a year to the militia would be to foster in our midst a politico-military institution which, under the careful mothering of the machine politician, might easily develop into that sinister "militarism" of which we hear so much in the present hour.

Now, in spite of the fact that the President has recently said: "There is nothing extravagant about an army of 250,000 men," notwithstanding that the proposed army has the backing of our highest military experts, and in total disregard of the earnest appeal of the country for *adequate* preparedness, the House of Representatives has seen fit to cut down the regular army to 180,000 men, throw out the Federal volunteer army altogether, and commit the defense of the country to a Federalized and paid militia, with all the evils of constitutional uncertainty and political abuse which may readily follow in its train.

Why is it that our military men as a whole, not a few of the members of the National Guard, and all of those civilians who have made a study of the past history and the present conditions in our state militia, are so strongly opposed to the proposed militia legislation? It is not that they are hostile to the militia men as such, or that they fail to recognize that in some states the National Guard is a well organized, patriotic and, so far as the limiting conditions permit, an efficient force. The objection in the majority of cases, we believe, and certainly so far as the SCIENTIFIC AMERICAN is concerned, is based upon the conviction that the whole history of our militia shows that to rely upon them as numerically the main element of our defense is to rest, as George Washington once said, "upon a broken staff."

By way of showing how diametrically opposed is the present action of the House of Representatives to the experience and teachings of Washington, we quote the following from his writings: "The jealousy of a standing army and the evils to be apprehended from one, are remote, and in my judgment, situated and circumstanced as we are, not at all to be dreaded; *but the consequence of wanting one, according to my ideas formed from the present view of things, is certain and inevitable ruin.*"

The above is from Sparks' "Writings of Washington," and from the same work we quote what Washington said in a letter to the President of Congress, dated December 20, 1776: "It is needless to add that short enlistment and a mistaken dependence upon the militia have been the origin of all our misfortunes and the great accumulation of our debt. We find, sir, that the enemy are daily gathering strength from the disaffected. This strength, like a snowball by rolling, will increase unless some means can be devised to check effectively the progress of the enemy's arms. Militia may possibly do it for a little while, but in a little while, also, and the militia of those states which have been frequently called upon will not turn out at all, or if they do it will be with so much reluctance and sloth as to amount to the same thing. . . . Can anything be more destructive to the recruiting service than granting a $10.00 bounty for six weeks' service in the militia, who come in, you cannot tell how, go you cannot tell when, and act you cannot tell where, consume provisions, exhaust your stores, and leave you at last at a critical moment? These, sir, are the men I am to depend upon ten days hence; *this is the basis on which your cause will and must forever depend till you get a large standing army sufficient of itself to oppose the enemy.*" (The italics are ours.)

Far be it from us to draw any invidious comparison between the militiaman of to-day and his predecessor who so sorely tried the patience and faith of Washington himself. Undoubtedly, the moral fiber of the modern National Guardsman is of much finer quality. But having said that, let us look squarely in the eye of the fact that the faults of the militia system, the *inherent* faults of the system, are just as great to-day as then, and let us remember that an institution which broke down so deplorably in front of the easy going British Army of Revolutionary times would shrivel up like a wood shaving before the fierce blast of a highly trained twentieth century army equipped, as it would be, with the overwhelming artillery of modern warfare.

The hope of preparedness in the presence of this wretched fiasco in the House of Representatives lies in our President and his consciousness that he has the all but unanimous voice of the country behind him in his stand for an adequate army. More than once in a crisis such as this Mr. Wilson has laid a firm hand upon Congress and swung it into what he believed to be the path of honor and duty.

There is a call for such action by the President to deliver the army bill from the political toils into which it has fallen.

The Completion of the Rhone-Marseilles Canal

FRANCE although engaged in a gigantic conflict which has called forth every military and practically every industrial resource at her command, has found time to bring to a successful consummation a great engineering undertaking, namely, the Rhone-Marseilles Canal. With the élite of her manhood engaged in the most sanguinary warfare with a military organization the like of which the world has never known before, the opening of the promising waterway at this time speaks well for the stability of the Republic's enterprises.

Marseilles is France's great port of entry for the Mediterranean Sea, although Nature caused it to be walled off from Central France by a mountainous range that sweeps around the northern side of the city. Before the advent of railroads the question of providing a waterway between the port of Marseilles and the important industrial cities in the interior was a much mooted one. As early as 1820 a canal was officially proposed by Becquey, the then director of bridges and roads. With the appearance of railroads the project was momentarily forgotten, although in the intervening years it was constantly before the French Government. But it was not until 1904 that the proposals gave way to actual work on the canal. On May 7th last, in the presence of a distinguished gathering of members of the Cabinet and other officials, the Rhone-Marseilles Canal was officially opened.

The total length of the canal is 60 miles, and it has for its main feature a five-mile tunnel through a mountain. Leaving the port of Marseilles, the canal follows the coast line up to the point where the tunnel is entered. Emerging at the other end of the tunnel, the canal utilizes two salt water lakes, the larger being the Etang de Berre, finally debouching into the Rhone at Arles. The canal in the sections on a straight line is 82 feet in width, with a depth of water of 6 feet 6 inches, the normal depth, however, is 8 feet 2 inches. Between Marseilles and the Etang de Berre it is 9 feet 10 inches, the reason for the greater depth in this section being that larger craft, such as sea-going barges, will pass through it because of the prospective development of a number of industrial establishments on the salt water lake. From this fact it may be assumed that goods in many instances will be transhipped from the larger barges to smaller craft that ply the Rhone River. The locks of the canal are 52 feet 6 inches in width at the entrance and 525 feet in useful length. Throughout, the canal has been constructed to accommodate barges up to 600 tons capacity, and it is believed that these craft will be able to travel up the Rhone, Saône and Doubs rivers, at a total distance of 385 miles, without breaking bulk.

That portion of the canal which pierces the mountain range and is known as the tunnel of the Rove was first designed for a width of 59 feet at the springing of the arch, and was to have a towing path 4 feet 11 inches in width, forming a bracket, over the whole length. Fearing that difficulty might arise when two barges passed each other, the Marseilles Chamber of Commerce requested that the tunnel should be wider, with the result that it has been given a span of 72 feet 2 inches, with two side paths, 6 feet 6 inches in width each, leaving 59 feet for the canal width.

Perhaps the press reports regarding the official opening of the Rhone-Marseilles Canal have been too enthusiastic in visioning the great use to which the new waterway is to be put in the immediate future. The statements that the new canal, like the Kiel Canal of Germany, will be of strategic value in permitting the movement of destroyers and small war craft between the Mediterranean and the North Sea, appear to be premature, at least judging from an authoritative report on the condition of the Rhone River. The latter is a difficult waterway for traffic, and will always continue to be so. Its flow is ill-suited to modern navigation methods with large craft, yet large craft must be resorted to in order to reduce the cost of transportation. While there appears to be an abundance of water in the river, its bed is very irregular, preventing the water from spreading evenly over its entire length and breadth, and as an additional obstacle, sandbanks are constantly forming. In sum, the Rhone must be considered in the light of a torrential flood. Were it not for these conditions, direct communication by water between Marseilles and Belgium and the Rhine would be readily realized. But the obstacles that have thus far been overcome would seem to indicate that with the same kind of perseverance and skill a navigable waterway from the Mediterranean to the North Sea is not an impossible achievement of the future.

Climatology and the War

THE climatic survey of the globe is an endless task, depending for its prosecution upon the patient collaboration of thousands of people. Day in and day out instruments must be read at fixed hours at an immense number of places. Month by month and year by year the results of these readings must be collated, summed, averaged at various central offices and observatories. Continuity of the records is extremely important. Missing observations may, it is true, be interpolated from the records of neighboring stations, if such exist, but the value of the series is always impaired to a certain extent by this process.

The fruit of all this labor is a body of statistics that furnishes, on the one hand the substructure of investigations in the many branches of science in which meteorology is a factor and, on the other, information directly applicable to the practical needs of agriculture and other human activities.

In the period of relative tranquillity preceding the present upheaval in the Old World the climatic survey was expanding at a rapid rate. Nowhere was the work more actively carried on than in the colonial possessions of Germany. Already it had become possible to draw quite satisfactory rainfall and temperature charts of such newly explored countries as German East Africa, German Southwest Africa, Kamerun and Togo. The older French and British colonies in Africa had also become climatically well known. In the Far East, in the South Seas, in South America, the spread of the climatological *réseau* went on apace. Western Europe, long provided with a dense network of stations, was turning out commendable digests of their records.

The effects of the European war upon these undertakings cannot yet be fully gaged, but climatologists already stand aghast at disasters that must be taken for granted. Germany, we hear, has managed to keep nearly all her meteorological stations in continuous operation, but what of Belgium? Perhaps some of the observers in that stricken country have heroically stuck to their thermometers and rain gages, and perhaps the enterprising Teutons have, here and there, taken up the work where the Belgians left off, but many of Belgium's longest unbroken series of observations were in progress at towns that are now heaps of ruins. There cannot fail to be a sinister gap in the copious file of meteorological reports for the kingdom which has issued for so many years from the Royal Observatory at Uccle. Northern France is in the same plight. The meteorological service of Serbia had a hard struggle to maintain its existence in times of peace. Is it conceivable that it has survived the political disasters of the past year?

What effect has the war had upon the meteorological work of the well-organized corps of observers—officials, planters, missionaries and others—in Germany's former African colonies? At the present writing it is only possible to speculate as to the effects of the war.

Electricity

An Electrically-Operated Tire Inflater of compact and readily portable design has recently been placed on the market by an American manufacturer It is an ingenious combination of a universal electric motor that will operate on either alternating or direct current, a high-pressure air compressor, a gear box, and a condensing chamber so arranged that all elements are enclosed in a single housing and are automatically cooled by a patented cooling system that requires no liquid of any kind. The smaller model is provided with a handle so that it may be readily carried about

Novel Uses of Hand Magnets — There has been introduced recently a hand magnet which is but a trifle heavier than an electric iron and is designed for connection to any lamp receptacle or socket. It is suitable for clearing up chips and borings for separating brass from iron chips or filings, for handling warm or awkward shaped castings in foundries, for dipping metal pieces in paint, for recovering nails from sweepings in shipping rooms, and for hundreds of other purposes A push button for turning the current "on" and "off" is located in the handle

Rapid Screening by Electricity —Under the name of the "gyratory riddle" there has been introduced an electrically-operated machine which permits of the rapid screening of sand and other materials. The machine consists essentially of a frame work, a one third horse-power motor, a common sieve, and the mechanical movement. The sieve is given a gyratory motion by the mechanical movement, which in turn receives its power from the motor It is claimed that the capacity of the machine is very high, and that it will sift sand faster than a man can shovel into it The machine is readily portable and can be operated by current from any lamp socket.

Killing Trench Rats by Electricity — Numerous have been the methods employed by the soldiers in the French trenches to kill the rats which constitute a veritable plague in the Western war zone, but perhaps none has been so interesting—and so effective—as the electrical method A trough is excavated along a rat run adjoining the trenches, and over this are placed three wires running parallel to each other A constant supply of current is maintained in the wires, which are spaced only a few inches apart. The rats in crossing the trough come in contact with the wires, resulting in immediate death. It is reported that hundreds of rats are killed each week by this method

Electric Vibrator for Foundry Work —To facilitate the rapping of patterns for which purpose air vibrators are now employed, there has been developed an electric vibrator of simple yet efficacious design The vibrator is said to be especially well adapted to use on benches, squeezers and heavy moulding machines Essentially, the new vibrator consists of a metal plunger with hardened ends, which is actuated by solenoid coils housed in a smooth cylindrical steel case The coils cause the plunger to strike hardened metal anvils at both extremities of the stroke By means of magnetic force the plunger is maintained centrally in the solenoid tube, thus there is no friction and hence no lubrication is required The vibrator is designed for alternating and direct currents.

Electric Vehicles for Wounded Soldiers —Electric wheel chairs similar to those employed at the Panama Pacific International Exposition last year are being used successfully in Europe for the wounded and crippled soldiers. Invariably the convalescent men prefer to direct their own chair than to have some one push them about. One of these chairs, which is of Swiss make and costs but a small sum, is equipped with a ¼ horse-power motor suspended between the steering and rear wheels. Current is supplied from a battery of 15 lead plate cells housed in three boxes beneath the seat. The battery is of 50 ampere hour capacity and provides sufficient energy for a run of 30 to 40 miles Five forward and five reverse speeds are provided The steering and operating mechanism is of the very simplest.

Testing of Incandescent Lamps for Government — The lamps purchased by the Federal Government, amounting to about 1,250,000 annually, are inspected and tested by the United States Bureau of Standards. The specifications, under which they are tested, are published by the Bureau and are recognized as standard by the manufacturers as well as by the Government. They are used also by many other purchasers of lamps. The lamps are first inspected for mechanical and physical defects, this being done at the factory by Bureau inspectors. Representative samples are then selected and sent to the Bureau, where they are burned on life-test at a specific efficiency at which they must give a certain number of hours life, depending upon the kind of lamp. About 5,000 lamps are thus burned on test each year. For this test great care must be taken in the measurement of the lamps and the adjustment and regulation of the life-test voltage.

Science

Instruments for Measuring Solar Radiation — Instruments of this category have increased considerably in number and efficiency in recent years, but the literature concerning them is scattered through the files of scientific journals and is not easy of access We therefore welcome the appearance, in separate pamphlet form, of a comprehensive history and description of such instruments by Mr Robert S Whipple originally published in the *Optician and Photographic Trade Journal* The memoir is fully illustrated and provided with bibliographic references

A Flora of the Northwestern United States — Messrs C V Piper and R. K. Beattie have recently published a much needed addition to the list of American floras in the shape of one for the part of Washington and Oregon lying west of the Cascade Mountains and between 43½ and 49 deg N latitude The northern range of many of the species extends well within the boundaries of southern Alaska The work includes descriptions, with keys of 1 017 species of which seven are new to science The work is based largely on herbarium material at the State College of Washington

Crow Roosts —Writing in the *Yearbook* of the U S Department of Agriculture Mr E R Kalmbach, of the Biological Survey describes one of the most wonderful of bird phenomena still existing in close proximity to large cities ' in this country, viz the roosts at which crows gather nightly in enormous numbers during the colder months of the year A roost is usually a stand of trees, especially pines and other evergreens though one of the most populous of the earlier known roosts was a low reed covered island in the Delaware River entirely destitute of trees known as the Pea Patch Crows have also been observed roosting in open fields and on exposed sand bars Roosts are often in the immediate vicinity of cities One at Arlington Va just across the Potomac River from Washington was supposed to have contained at the height of its occupancy from 150,000 to 200 000 birds Several other equally populous roosts have been recorded while some observers have estimated the population of individual roosts at millions Fortunately the birds that gather in one spot in such numbers at night feed over a wide area as a rule, by day so that the roost is not so serious a menace to crops in its vicinity as might be expected

Upper-air Observations in Canada have now been in progress for more than five years the first sounding balloon having been sent up from Toronto, February 3rd, 1911, and the first meteorological kite February 28th, 1911 The Canadian Meteorological Office has just published, in one volume, the detailed results of all the balloon observations down to April, 1915 The majority of the balloons were sent up from Woodstock about 100 miles WSW of Toronto As indicating the drift of the atmosphere in that region it is interesting to learn that only four balloons were found, after their fall, west of the starting point The mean direction of travel was due east Of 94 balloons sent up, 53 were recovered In one case the balloon was not found until 13 months after its ascension, but its meteorograph record was still quite legible The results agree with those obtained in Europe in showing that the stratosphere or "isothermal layer" of the atmosphere is higher in summer than in winter but differ from the European results in showing the stratosphere to be warmer in winter than in summer, the average seasonal difference being 6 deg Cent This is possibly due to the fact that Ontario where the observations were made, is east of a continental area, while Europe is east of an oceanic area

Thunder at Sea —In consequence of a note published in the SCIENTIFIC AMERICAN of June 19th 1915 recording a discussion at meetings of the Astronomical Society of France in regard to the audibility of thunder at sea the Carnegie Department of Terrestrial Magnetism instructed Captain Ault master of the Carnegie to investigate this question in the course of a voyage from Dutch Harbor Alaska, to Port Lyttleton New Zealand August 6th November 2nd, 1915 Lightning storms or displays were seen on twenty two different occasions but they were accompanied by thunder on only six occasions. In these six cases the distance of the nearest land was from 50 to 600 miles In all cases, however where streak lightning was seen, thunder was also heard The other cases were sheet lightning It has been suggested that the frequent inaudibility of thunder at sea may be due to the fact that the sound of the thunder is drowned in the noises on shipboard during a storm The "Carnegie," however, observed lightning without thunder several times in calm weather In one case in which several claps of thunder were heard the successive intervals between flash and clap showed that the storm became inaudible when its distance exceeded 5 miles from the ship. The observations will be continued during the remainder of the present cruise of the "Carnegie."

Aeronautics

More Powerful Aeroplanes for Army —The War Department has decided to abandon the old 90 horse-power aeroplane for military use except in the training schools, due to the experiences of the aviators in Mexico Orders have been placed for four new Curtiss biplanes of 100 horse power, conditional on satisfactory tests that are to be conducted at Newport News It is known that the new machines are considerably larger and have far more lifting power Their speed is as high as 95 miles an hour

The Society of British Aircraft Constructors has recently been founded in England and has among its numerous objects to encourage promote and protect the British aircraft industry and generally to watch over and protect the general interests of companies firms and persons engaged in such aircraft industry but independently of the personal interests of any company firm or person It proposes too, to originate and promote improvement in the law concerning aviation to support or oppose alterations therein, and to effect improvements in administration It is also proposed to maintain a statistical department which will collect and collate statistics relating to the industry

Electrically-Heated Gloves for Aviators —A British firm has recently introduced a line of electrically heated gloves for aviators Cold hands and feet are among the prime discomforts experienced by airmen flying at high altitudes and it is obvious that numbed hands in particular may lead to disaster Ordinary gloves, irrespective of their thickness are of little use The electrically heated gloves on the other hand maintain the hands at a comfortable temperature As in the instance of the electrically heated gloves for automobile drivers, electrical connection is made between small brass disks on the gloves and metal plates on the steering wheel of the aircraft

Why the Navy Needs Seaplanes —Aeronautic units are to be developed within the United States fleet for the purpose of directing the fire of battleships at extreme ranges With seaplanes it is expected that effective fire can be maintained at a distance of 17 000 to 18 000 yards according to the *Aerial Age Weekly*, which states further that the naval engagements in the North Sea indicate that there has been effective firing at 17,000 yards. In the spring target practice of the United States Navy it is thought that with the assistance of seaplanes, by which the range can be corrected and the result of shots observed, interesting results may be obtained

Engagement Between Submarine and Seaplane.— Anthony Jannus an aviator and representative of an American aircraft builder, tells of an interesting engagement between a submarine and seaplane which he witnessed while on board a Russian ship during the aerial bombardment and destruction of the Turkish Black Sea port of San Codac He states that a Turkish submarine had crept up unobserved on a Russian seaplane which was resting on the surface and launched a torpedo The missile grazed one of the planes but did not explode. Before the submarine could dive, however the seaplane arose and with accurately aimed bombs destroyed the submarine

Record Non-Stop Flight of Army Aviators in Mexico — Lieuts Edgar S Gorrell and Herbert A Dargue made a record non stop flight and brought in messages from the front to Columbus New Mexico For several days we had been without information regarding what was transpiring with the flying column of cavalry owing to the insufficient range of the field wireless Consequently, when these two intrepid aviators arrived with messages for General Funston every one was greatly relieved For their flight the aviators used one of the five 90 horse power Curtiss tractors that are still in commission out of the eight with which operations were begun in Mexico They averaged nearly 90 miles an hour which was extremely good considering the treacherous air currents in the mountain districts

Teuton Air Losses in the War — Estimates of German and Austrian air losses since the inauguration of the war are as varied as they are numerous Among the latest is that of the Italian *Giornale dei Lavori Pubblici*, which states that definite news has been received from a most competent source that since the beginning of the war Germany has lost 47 Zeppelins and 368 aeroplanes the number of airmen killed or captured in connection with these losses being 1,400 Germany has constructed 40 new Zeppelins, over 30 of these are now in service and the remainder are nearing completion. Austria is said to have lost all her dirigibles and 184 aeroplanes and has not been able to replace the former Since the article in which these figures were published appeared some two months ago the losses shown do not include the heavy toll in Zeppelins and aeroplanes recently exacted by the Allied forces However, it would seem that the figures given are somewhat higher than the usual run of estimates

Industrial Preparedness for Peace

VII Cutting Costs in the Paper Mill

By Miner Chipman

THE price of paper in all lines has risen to figures running from 50 per cent to 100 per cent higher than those prevailing before the European War High grade bonds which previously retailed for 25 cents or 20 cents per pound, are now selling for 50 cents per pound, with little to be had at that price The paper mills are rushed with orders, and crying for raw material The raw materials shortage includes foreign rags, foreign sulfite, and foreign chemicals, dyes, etc One of the largest printers in the country has told me that the printing business was having a boom, notwithstanding the tremendous increase in the cost of materials Many of our paper manufacturers are awaiting the close of the war, that the avenues of trade may reopen, and thereby bring their production up to normal This "waiting" program is not Industrial Preparedness for Peace. We cannot include under this heading of Preparedness, the mere development of local producing agencies for these raw materials which have been heretofore exclusively imported The program for Industrial Preparedness goes much deeper than that

The slips of paper in the roll indicate "side cracks." A side crack means a stopping of the machine, pasting the ends, and restarting

Scientific Management in Paper Making

The application of the principles of scientific management to the manufacture of paper is quite different from that of applying the same principles to machine-shop processes. The division of labor, found in machine trades, has not been, and never will be developed in the paper mill A division of labor exists, but such divisions as exist cover trades in themselves, with their own distinctive technique In a general way, paper making may be divided into the following classification, as to its educational or experimental content, as an occupational problem

(1) Chemistry (2) Mechanics (3) Manual Labor (4) Mental Labor (5) Trade Technique

Nearly every job in a paper mill contains elements of these five divisions The paper mill is a process of almost infinite variables About the only constant factor in a paper mill is trouble, and even this has a vexing variation The making of a particular grade and quality of paper is not the same proposition as that of manufacturing a certain gear, wheel, or machine part. There is nothing "fixed" in paper manufacture. One of the most impressive and interesting mechanical processes in modern industry is the operation of the modern high speed paper machine The "machine" is the heart of the mill Its production regulates all other processes in the mill Everything else is in dependent sequence to the paper machine's efficiency and production Scientific management has been applied, with success, to the operation of this important factor in paper manufacture A modern paper machine costs, including housing, anywhere from $100,000 to $250,000, and paper makers have left no stone unturned to plan orders and despatch them to the "machine" with the least possible delay In a large mill manufacturing fine book papers the average shut down of paper machines did not exceed 2 or 3 per cent in an entire month The opportunities for savings and increased efficiency in the paper mill do not lie in the operation of the paper machine itself but in the numerous and complex operations which precede and follow the paper machine as a factor of production

One of the largest paper manufacturers in this country employed an efficiency expert to make a survey of his mill, and introduce the principles of scientific management, where practicable, into its operation The story of the efficiency work carried on in this mill is one of the most interesting chapters in the history of scientific management As an example of Industrial Preparedness for Peace, a brief description of the work as applied to the single operation of calendering, will give an adequate conception of the possible savings in paper manufacture These savings are possible, entirely outside the raw material problem, and bear no relation whatsoever to European conditions, German competition, or the dyestuff problem The savings made in this department of a large and prosperous paper mill illustrate the general possibilities in the trade as a whole, and the kind and character of savings which we include under the term of Industrial Preparedness for Peace

Calendering Coated Paper

This process may be divided into any number of operations For convenience, we have classified it under six different headings

1 High speed
2 Slow speed
3 Breaks in paper, pasting ends, etc
4 Making ready
5 Taking sample
6 Unavoidable delays.

Any operation that a workman performs about his calender may be placed under one of these headings We shall explain each one separately

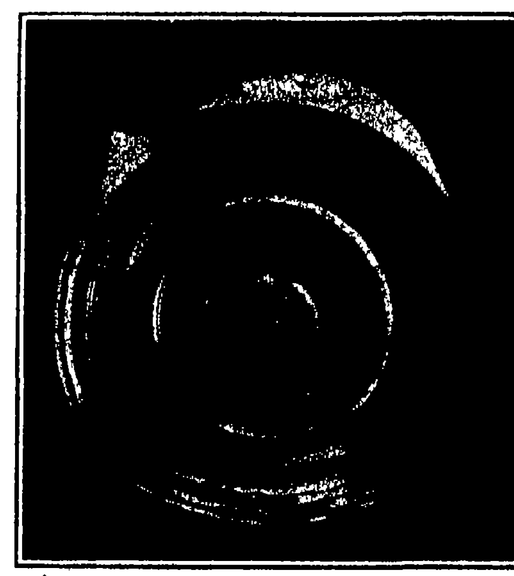
1 *High Speed* When a calender is on its high speed, with the weights down and the paper running smoothly, it is doing productive work All the other operations are merely side issues necessary to bring the stack (calender) to the desired condition, *i e*, of running on high speed It follows that all items such as low speed, pasting ends, making ready, etc., should be made as short as possible so as to increase the time on high speed.

2. Low speed is necessary in starting, or when a poor spot in the paper is about to pass between the rolls.

3. Breaks in paper, pasting ends, etc. Under this heading we have included all of the time from the stopping of high speed (in order to mend a break or paste an end) until the high speed is again started

4. Making ready includes the time from the finish of high speed on one roll until the starting of high speed on another It includes such operations as (a) taking finished roll out of bearings, (b) placing finished roll on rack, (c) placing new roll in bearings, (d) putting paper through stack, and other features.

5 Taking sample—(for inspection of foreman)



A roll of paper like this causes high cost to the manufacturer, reduction in output, loss of bonus to the worker, and a high percentage of waste

6 Delays This heading is inclusive of delays, for which the operator is not responsible, such as interruption of powder

The first step in standardizing the work of calendering was to bring the machines up to standard speeds. This was accomplished with such success that the average speed of the 19 machines showed an increase of 90 feet per minute. This means an increase in output of 375 pounds of paper per hour

Careful studies of the various machines were then made and a standard of efficiency established for each, indicating the percentage of the operator's time which should be devoted to each of the six fundamental operations described above It was then possible to maintain a close watch over each machine, and make intelligent efforts to keep it running at high efficiency It should be noted that under this system a machine may attain an efficiency of more than 100 per cent simply by exceeding the standard laid down for it.

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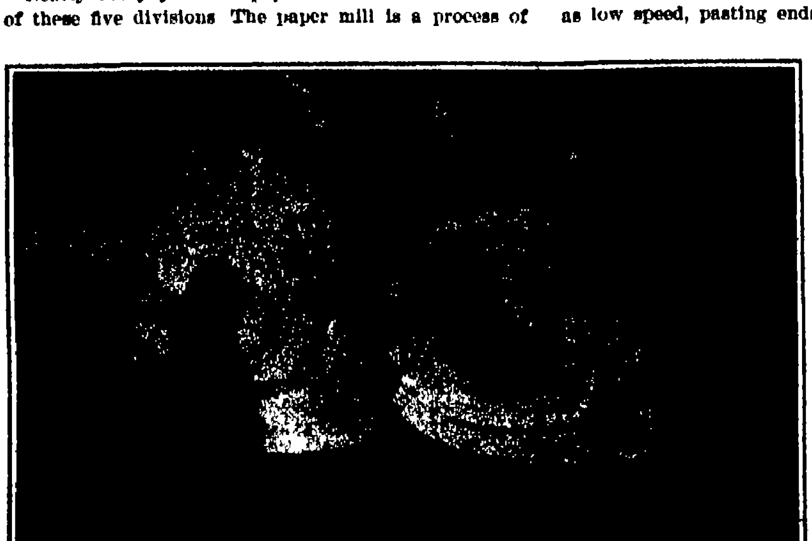
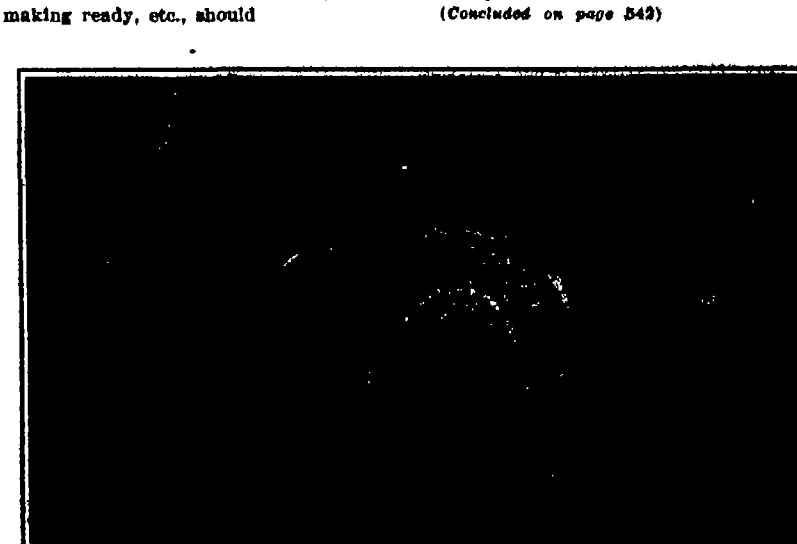
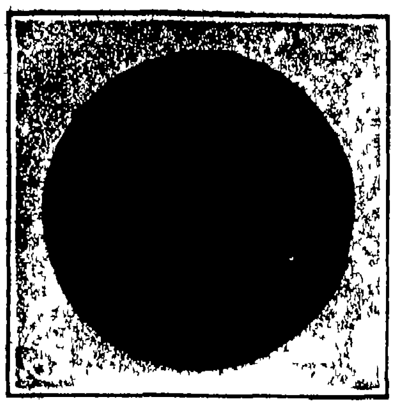


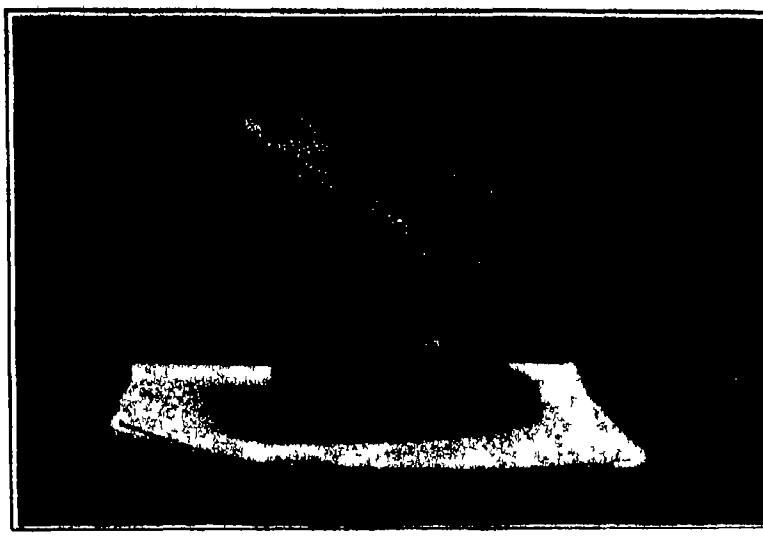
One of the causes of high-cost. Loosely wound rolls are difficult to calender, causing delay, inefficiency and waste



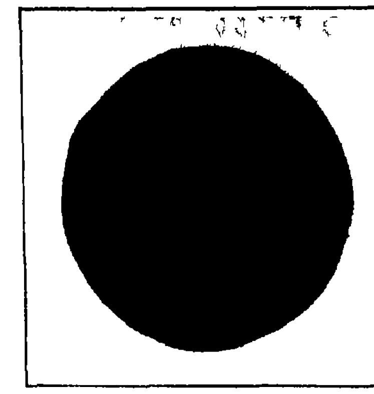
Preventable waste: writing on the end of a roll causes "side-cracks." Loosely wound rolls with "side-cracks" and no markers



A badly dented piece of wood before treatment



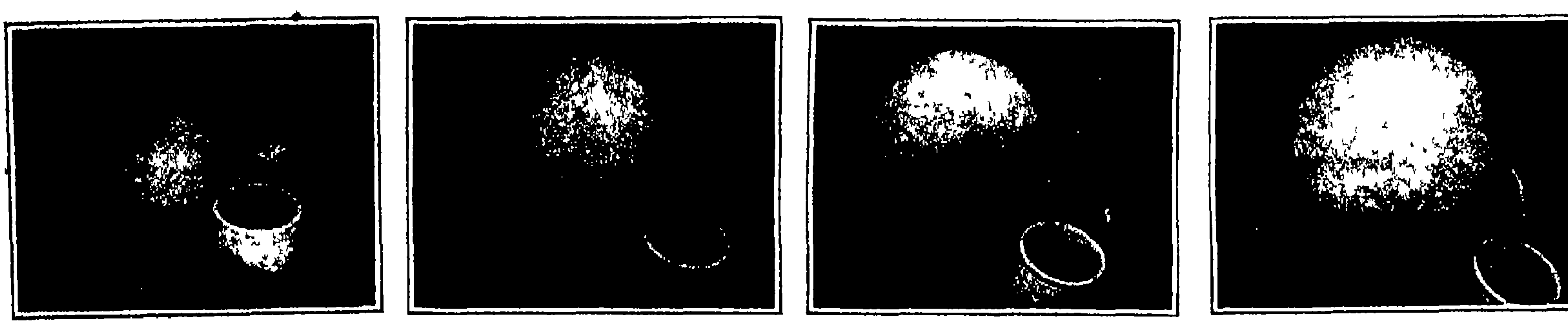
Removing dents from furniture with damp blotting paper and a hot iron



After treatment repolishing will clear away the slight marks

Removing Dents from Furniture

WHEN wood is badly dented or scratched it is often a problem to know how to get rid of the marks. This is quite easy if the following plan is adopted First of all fold a piece of blotting paper at least four times, then saturate with water, finally allowing the superfluous moisture to drip away Now heat a flat iron until it is about the warmth required for laundry work. Place the damp blotting paper over the dent and press firmly with the iron As soon as the paper dries examine the mark It will then be found that the cavity has filled up to a surprising ex tent. Where the dent is very deep a second, or even a third application on the lines indicated might be tried Sooner or later even serious depressions can be drawn up, and most people who have not tried this plan will be surprised at the result of the treatment The accom panying photographs show a dented piece of wood be fore and after the application of the iron Re-polishing will clear away even the slight marks that might finally remain



How the pumpkin fattened on the sugar solution Photographs made on successive days from September 4th to 7th inclusive

Feeding a Pumpkin with a Sugar Solution

By S. Leonard Bastin

SOME interesting experiments have been recently carried out to prove that the growth of gourds and pumpkins may be accelerated by artificial means It has for some time been known that many plants greedily absorb sugar solutions, but it is only recently that the idea of feeding a growing pumpkin has been developed

The plan is carried out in the following manner A healthy young fruit is selected for the experiment a few days after it has definitely "set." Next, a very strong sugar solution is prepared in the following way One or more jars are taken and each of these is filled with water Raw sugar is then stirred into the water until the liquid has absorbed all that it can take up The sugar and water should not be boiled as this will produce a thick mixture that will not be freely imbibed by the plant On the other hand there is no harm in order to assist in the dissolving of the sugar if the water is slightly warmed

The next thing is to secure some pieces of cotton through which the sugar solution will pass Actually round cotton lamp wick answers the purpose very well It is a good plan to use not less than a couple of jars of solution for every pumpkin These are stood one on either side of the fruit, sunk a little into the ground, so that there will not be a danger of overturning A con nection must now be made between the pumpkin and the sugar solution Two pieces of the wick are cut, these being measured so that they reach from the stalk of the pumpkin well down into the mixture in the jars. It is now needful to prepare the openings in the stalk so that the free ends of the wicks can be inserted into the tissue The holes may suitably be worked out with a penknife, care being taken to avoid penetrating the stalk right through at any point When the holes have been opened up the ends of the wicks are fitted in such a way that they are pushed well "home" into the openings Nothing now remains save to see that the jars are well supplied with sugar solution. The con tents of the jar is well stirred two or three times a day in order to prevent a large amount of sugar from settling to the bottom

The rate of growth evidenced by the pumpkin is astonishing It will be found that the fruit grows three or four times faster than those specimens which are not fed at all It is easy to find out the increase in weight by placing the fruit on to a pair of scales from time to time Care must be taken to avoid injuring the stalk in any way As regards the increase in size a glance at the accompanying photo-graphs will show how the pumpkin jumps when it gets its first taste of the solution Within certain limits there does not seem to be any reason why pumpkins should not be grown in this manner to almost any magnitude

New Serum for Restoring Life to Apparently Drowned Persons

SEVERAL physicians of the Johns Hopkins Hospital of Baltimore Md are at present experimenting with a serum which they are said to have used with success in the laboratories in restoring cases of asphyxia tion and drowning in animals several hours after life has been practically extinct There appears to be one drawback in the results thus far however, in that in the majority of instances there have been serious after effects such as high blood pressure or hardening of the arteries.

If the serum is to be perfected and more than likely it will be, the physicians are of the opinion that it can be injected into human beings several hours after the accident and restore them to life In one case the serum was used on an animal that had been apparently dead from drowning for a period of four hours. The animal was brought back to life but it died a short while later from blood pressure. Other cases, report the physicians have been successful

How the pumpkin was weighed on a small scale

The sugar solution was fed through cotton lamp wicks

Strategic Moves of the War, May 12th, 1916

By Our Military Expert

AFTER a lull of inactivity in the Verdun sector, a pause which has almost universally been accepted as final acknowledgment that it is a physical impossibility, with the forces available for Germany to break the lines of General Petain, powerful attacks have again been directed upon that part of the French defenses, in particular west of the Meuse.

Le Mort Homme and Hill 304 have figured prominently in the war dispatches. By putting two and two together comparing various admissions of attack and claims of defense it is evident that the constant hammering of the Kaiser's troops against the lines of their adversary has resulted in a slight beating back of the French positions which were not long since fairly well extended down the slopes of these important hills. The German position seems to have bent itself around these two eminences dipping into the valley between them until the outline of their advanced position resembles the form of a Cupid's bow the handgrip being represented by the thrust into the ravine the tips of the bow embracing the northern and flank portions of the hills.

The German method of attack has lately become that expensive one of blanketing the entire position about to be assaulted under a heavy concentration of artillery fire, the employment of hundreds of thousands of high explosive shells.

It is too much to expect that anything could live under the rain. The French trenches were absolutely obliterated and when the Germans thought the propitious moment had arrived, tremendous forces moved quickly forward to occupy the line of craters, the former trenches.

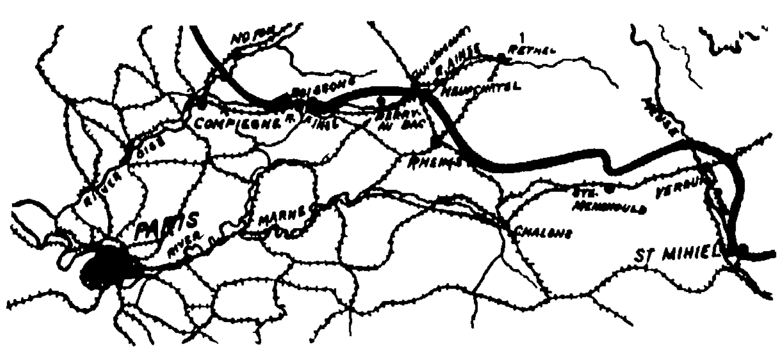
The French method of defense, however, has been deadly. It appears that fewer and fewer troops are left to hold the first line trenches with each day of battle, but the bulk of the containing force remains snugly under ground until the infantry assault is about to reach its objective, when a thousand shell proofs and craters give up the greatest military factors of the war—after the artillery—machine guns. It is absolutely impossible for infantry not under cover to withstand the sweep of these weapons if they are in sufficient number adequately to cover the position, and the French, according to report, have introduced the automatic rifle into service, practically a hand machine gun.

Hill 304 has been acclaimed the key to the French position by many analysts of the operations in the sector. But an observer recently returned from the actual theater of war, one who has seen with his own eyes the lay of the land and to whom the actualities of the position have been explained by French officers of high rank, has made the definite statement that the real lines of defense west of the Meuse—and the real defense of Verdun does lie west of the river—is to be found in the grim line of hills and plateaux several miles to the southward of Le Mort Homme and Hill 304. In effect this makes these latter hills but advanced posts of defense positions strong enough in themselves to serve as barriers if properly held but which can be given up without appreciable damage to the real defense of the city, or, more accurately, the principle of holding Verdun for as a city it no longer exists.

The renewed activity seems more of an attempt to retain the French defenders in position while other affairs of moment are brewing, than confident attempt to break the line. For weeks on end Germany sought to reach a decision favorable to herself by a monumental thrust at the Verdun salient. Blood was poured out like water in the attempt, reserves of munitions were expended unstintedly, but without effect. The retirement of the defenders to more defendable positions was but a logical and scientific move and it cost nothing but the surrender of a few more miles of French territory which had become nothing but a shambles.

The vicinity of Soissons and Compiegne lies much nearer to Paris than that of Verdun. It is almost due west from Verdun, this vicinity, about 160 kilometers, and the little items of activity which have been dribbling in for the past ten days seem to indicate great as yet unfathomed activity in this direction. If it is part of the Teutonic plan to swoop down upon the Soissons sector, naturally its directing genius would calculate for every advantage to accrue. For this reason it must be the part of strategy to keep the adversary in doubt as to his intentions, whether to retain full strength at Verdun in case the latest attacks should, after all, be but another attempt to reach decision at Verdun, or whether to shift his forces westward to meet a new attack much closer to Paris, the heart of France.

The sector embracing Soissons is officially known as the Soissonais, that immediately touching it to the northwest is Santerre through the center of which runs the Oise. It is almost at the juncture of these divisions that the lines meet in the greatest salient of all, the particular point which is nearer Paris than any other. There has been little report of activity in these sectors but for all that trench warfare of a sanguinary sort has obtained here throughout the war. The mere spectacle of massed and sustained assault has been lacking. But at this point is to be found one of the strongest natural positions of the entire line, especially along the Oise. Great forests and interlocking hills render the locality forbidding to attack, and so far it has been practically unmolested. The valley of the Oise, however, offers a tempting avenue of approach to Paris, one of the most feasible in existence if the line can be successfully forced. The salient offers as much of a threat against Paris as Verdun does against Metz—and the entrance to Lorraine. It is, above all, the most likely point of attack in a drive upon Paris. This is so universally recognized—and so anticipated by France that the lines of fortification in the vicinity have been made of surpassing strength—and resultantly they have been completely ignored by the Germans in their various plans of operations.



Relation of the battle front to Paris

Where the Germans are pounding at Verdun

This is no forecast of future movements, only a plain statement of fact. It seems as though a German movement of tremendous magnitude is under preparation somewhere in the vicinity, where it may break—if it does break—no one can say, but with every element of the war, every factor of time, necessity and desired achievement centering upon the desirability of a speedy decision somewhere, anywhere, it seems probable that the shortest line may not be longer ignored.

It is not at all improbable that another great German attack will be made somewhere between Verdun and the Channel. England has taken over the French trenches as far south as the river Somme—possibly farther to date—releasing thereby considerable French forces for use at Verdun. The forces of Great Britain afield, counting those actually on the line, in general reserve and on the lines of communication, probably number 1,500,000 men. France, deducting all losses up to the present, should have in the vicinity of 2,000,000 combatants, thus giving the Entente forces available on the western line the superior number of 3,500,000. Germany's available forces may be counted as about 4,000,000. But when one figures that a considerable portion of these are detached against the Russian line, holding that part of it which Austria Hungary is not, it cuts severely the numbers available for use in the west. In all probability, then, Germany is outnumbered in France in about the proportion that Germany outnumbered France during the earlier months of the war. But neither France nor England, nor both, are as yet able to meet the German superiority of heavy artillery, and this is a factor which will count heavily when the initiative is finally taken by the Allied troops.

While German blood has been shed in such profusion that in places the lines are tenuous because there are not enough men to occupy them in force, her heavy artillery material is intact and more numerous than ever before, while her munition factories have worked incessantly to turn out the necessary shells for their feeding.

It may be that the disparity in this respect has been remedied, France and England may have managed to get out a sufficient number of heavy guns to meet their requirements, but it is to be doubted. If the long heralded allied offensive is opened within the next few weeks the greatest reliance will probably be placed upon numerical superiority, with full consideration having been given to the big losses which must ensue.

The Current Supplement

A MOST interesting article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2107, for May 20th, is *The Military Rifle*, which surveys the history of the development of the breech mechanism of the rifles used by the armies of the different nations, and gives an illustrated description of the principles and details. There is another instalment of the valuable lectures on *Radiations from Atoms and Electrons*. *Thorium*, tells of the method for obtaining this rare earth which is the principal constituent of gas mantles. An article of much interest is that on *Artificial Limbs* which describes and illustrates a number of devices for cripples to enable the wrecks of the European war to lead useful lives. It is profusely illustrated. A third article of the valuable series on *Economy in Study* appears in this issue, this chapter treating of books and their educative use. *The Rennerfelt Electric Furnace* describes and illustrates a device that has been found very successful in Sweden for steel foundries. There is an article on *A Coating for Blue Print Paper* that will be appreciated by many as it describes an entirely new method. *How to Value Gems* describes the characteristics of a large number of precious stones and will be of general interest. There are also a number of shorter articles on subjects of wide interest.

Compression Test for Keel Block

AN important test was conducted recently by the United States Bureau of Standards to determine the ultimate strength of a cast iron keel block. As designed, the block was expected to withstand a load greater than could be exerted by any testing machine in existence. It did withstand the full capacity of the Bureau's testing machine (10,000,000) when the load was applied over the entire bearing surface of the block, but when the load was applied over part of its bearing surface, it failed at 9,680,000 pounds.

The test of the block itself was preceded by several preliminary tests to determine the strength of oak timbers, which are usually placed between blocks and the keel of the ship. At loads from 300,000 to 800,000 the timbers were completely shattered, the variation in the load depending entirely upon the variation in the area over which the load was applied.

After these preliminary tests the keel block was subjected to a load equal to the capacity of the machine. At about 6,500,000 pounds several sharp reports were heard, but after the full load was applied there was no apparent damage to the exterior of the block. On dismantling it, however, it was noticed that several of the webs of the various sections were cracked. It was then reassembled, and the load applied over a smaller area when it failed at 9,600,000 with a very loud report and almost complete shattering of the various sections, throwing parts of them to a distance of 12 feet.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Shackleford Post Roads Bill

To the Editor of the SCIENTIFIC AMERICAN

The Shackleford Post Roads bill passed the House in the present and previous Congresses. It is now referred to the Post Roads Committee of the Senate. The bill calls for a federal appropriation of $25,000,000 to be given states and communities to assist in the construction and maintenance of post roads, i. e., rural mail and star routes.

To a cursory observer this epoch making measure would be passed up as inadequate. The $25,000,000 would appear a mere drop in the bucket, and so it is when one compares the "drop" with the enormous amount of state and county funds poured in taxes, yearly, into the "bucket" of the nation or "buckets" of the states and counties of the nation Anyway, it will make radiating circles when it does drop, and it can't begin dropping too quick.

The Shackleford bill, if it becomes a law this session, will have a tendency to make more efficient the mail service of the nation. It ought therefore to appeal to the wisdom of the Post Roads Committee of the Senate and be reported favorably out of committee

All post roads emanate from railroad towns primarily, because the railroads carry the mail The railroads also carry the commercial sap of the nation the waybill that goes with this sap, the invoice, the letter the bill, the dun, the soliciting letter and the catalogue. Along the railroads, too, are stretched the afferent and efferent nerves of commerce, the telegraph and telephones wires, which regulate the flow of this commercial sap, so that an impingement at any point can be readily felt and located Freight consigned to railroads travels safe and secure under seal, train dispatcher and conductor till it reaches its destination It follows, therefore, that the railroads will, for some time to come, continue to be the commercial highways of the nation They are equipped for this. The towns also supplied with this commercial sap along the railroads will continue to increase in population and wealth Population and wealth mean taxes and revenue

In 1830 there were only 23 miles of railroads in the United States West of the Alleghanies was a trackless waste, producing a daily crop of dew which was uncollectible, and yet that was what our $15 000 000 investment in the Louisiana purchase of 1803 was paying us in 1830 and even later

Since Congress began to help the railroads to cross the trackless plains up to date a vast increase in land values has arisen One can walk all day inside "The Loop" in downtown Chicago and, bargain as he may, no block can be purchased for less than $15,000,000 Dollars have taken the place of dew in forest and on prairie. Towns have sprung up, an average distance of 5½ miles apart, on 350,000 miles of railroads, 2,300,000 miles of roads have been built up to those railroad towns, and of those 2,300,000 miles of roads the Government decided to select the most frequented so as to deliver the farmer his mail This was seventeen years ago To-day there are 1,100,000 miles of rural mail and star routes, or practically half the total mileage of roads

To me the improvement of these 1,100,000 miles of rural and star routes is as simple as the Rule of Three

If through unbroken prairie and forest the pioneer farmer and county court, with little or no funds and only using the mincing pick and shovel, could designate and build through sparsely settled territory 2 300,000 miles of roads, how long will it take the greatest nation on earth, with an ever increasing population (now 100,000,000), increasing revenue and mammoth road machinery, to hard surface just half of 2,300,000 miles of road? Well, if we have done the one in practically fifty years, we ought to do half in twenty five years, and in much less time if the pick and shovel are set aside for road machinery

Therefore it does not look a tremendously big job to hard-surface 1,100,000 miles of post roads after all. Look at what the county court has already done!

But suppose we build hard surface stretches of road past every rural mail box in the United States, there still remain gaps to be filled in along the interborough highway, where the rural mail wagon turns off at right angles to the road to circle and zigzag its way back again to town. It is plain this would be a hindrance to interborough traffic and travel wherever such gaps should exist. That should be easy Correct the gap, let it be a rod or a mile, and *there you are*

The average number of rural mail routes emanating from station stops on railroads in mid west and eastern states are three to a station stop. This is easily verified by the Post Office Guide. Now, as each rural mail route averages from 20 to 25 miles in length, such routes ought to interlace and overlap along this interborough highway Wherever they don't, a certain adequate amount of federal, state and county road building funds should be set aside to connect them, for by doing so, interborough highways for traffic, travel and military purposes are thus provided for

All railroads in the United States are military highways so strong that all the men and munitions that followed Alexander the Great, Hannibal, Cæsar, Napoleon, and "those that crossed the sea and drew their sounding bows at Agincourt —even including the expeditionary forces of to-day—could cross and recross them to-day and add nothing but *a polish to the rail* But at bridge, trestle and tunnel they are vulnerable A bomb dropped from an aeroplane or Zepellin could blow up bridge, trestle or tunnel and thus block an army from our interior posts rushing to the defense of a coast town to prevent a landing of 400,000 trained troops.

There is no use in the Government spending money unless some big national object is gained thereby Such an objective as the securing of supplemental commercial mail and military highways by the additional expenditure of enough money to build the connecting links between rural mail routes along our *best military highways*, the railroads, should appeal to all thinking men. It is scientific and not haphazard road construction. It is thorough and American. To obtain this objective a federal highway engineer should be appointed to fill a federal highway department, similar to some state highway departments He should take under him every state and county engineer, find out to a cent how much money is available in state and county for road construction, add thereto the federal proportion, and say "Gentlemen, build in this and that direction eight (ten or twenty) miles of post road and interborough highway" That's all He holds the plans

Roads and highways thus built, following a general plan would obviate the confusion and lack of design of independent county and state road construction. The state and county engineers are restricted in their work by state and county lines.

Let me illustrate A cobbler had a piece of leather to fit a shoe It was not broad enough He remarked, "There's always a bit o' leather in the hammer" He placed the bit of leather on the lap-iron and hammered it till it spread to fit the place.

Now with federal aid representing the hammer, the state represented by the lap-iron and the county road building fund represented by the leather, an intelligent cobbler (federal engineer) should plan and hammer till the gaps between railroad towns along the inter borough highways be also built

The Shackleford bill is incomplete until such provisions are made P H DALY

New York City

How the United States Weather Bureau Was Started

By Cleveland Abbe, its Founder and Organizer

MY boyhood life in New York city had impressed me with the popular ignorance and also with the great need of something better than local lore and weather proverbs. The popular articles in the New York daily papers by Merriam Espy Joseph Henry and others—notably Redfield and Loomis—had by 1857 convinced me that men could and must overcome our ignorance of the destructive winds and rains It was in the summer of 1857 (1858?) that I read the beginning of the classic article by William Ferrel in the Mathematical Monthly" I realized that he had overcome many of the hidden difficulties of the theories of storms and winds. From that day he was my guide and authority During 1859-1864, in the practice and study of astronomy with Bruenow at Ann Arbor and Gould at Cambridge, Mass I was impressed with the unsatisfactory state of our knowledge of atmospheric refraction Two years later my experience at Poulkova Russia, and at our Naval Observatory Washington seemed to justify my conclusion that astronomers who would improve their meridional measurements must investigate their local atmospheric conditions more thoroughly and to this end must have numerous surrounding meteorological observations In my inaugural address at Cincinnati on May 1, 1868 I stated that with a proper system of weather reports much could be done for the welfare of man, and astronomy also could be benefited

This suggestion was taken up by Mr John Gano, president of the local Chamber of Commerce, a committee met me, approved my plans and promised the expenses of the first trial I had the total solar eclipse of August 7, 1869, on my hands but immediately began to arrange for forty voluntary meteorological correspondents On my return from the eclipse at Sioux Falls city I stopped at Chicago and formally invited the Chicago Board of Trade to join in extending the Cincinnati system to the Great Lakes, but this invitation was declined by the Chicago Board of Trade. An editorial in a Chicago evening paper of Monday, August 16, 1869, stated the scientific basis of our observatory work

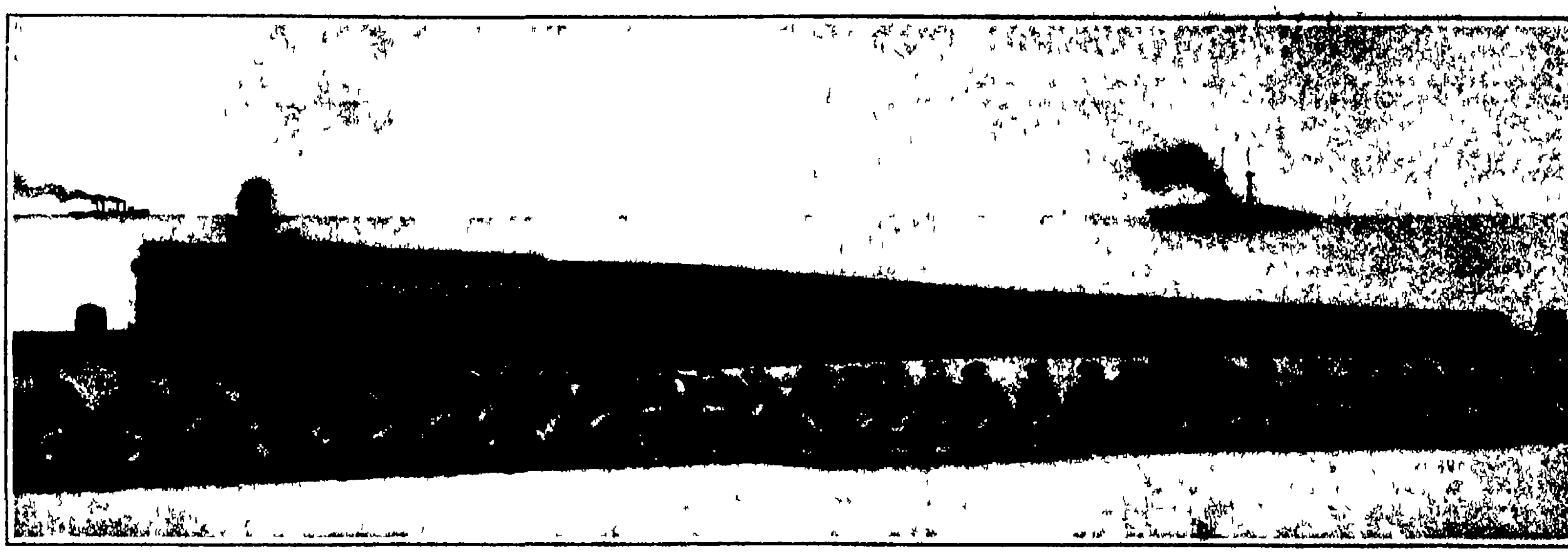
I returned at once to Cincinnati issued the first number of the Cincinnati Weather Bulletin promptly, as promised, on September 1 1869, it contained only a few observations telegraphed from distant observers and announced *probabilities*" for the next day This bulletin in my own handwriting was posted prominently in the hall of the Chamber but unfortunately I had misspelled Tuesday and I soon found below my Probabilities the following humorous line by Mr Davis the well known packer A bad spell of weather for Old Probs This established my future very popular name of Old Probs

My forecasts were treated very kindly by all I had anticipated a slow increase in accuracy, I ventured to write my father in New York city, ' I have started that which the country will not willingly let die ' I wrote a short note to the New York *Times* (or *Tribune*), telling them how useful we could be to their shipping. On September 3 1869 I even ventured to offer a daily telegram by the French cable to Le Verrier as founder of the Bulletin Hebdomadaire de l Association Scientifique' and who could fully sympathize with my hopes and plans He realized the breakers ahead of me better than I My daily telegram from Milwaukee came from the well known Smithsonian observer and author Prof Increase Allen Lapham He had known and appreciated the works of Espy, Redfield, Loomis and others, and although he had become absorbed in other studies, he urged the local Milwaukee society to do something for Lake Michigan. His friends were just about to go to the Richmond meeting of the National Board of Trade there they met William Hopper and John A Gano These merchants of Cincinnati found that they had the same idea as H F Paine of Milwaukee &c, that the Federal Government should develop the Cincinnati enterprise and make it useful to the whole country The National Board of Trade indorsed this idea, Prof Lapham of Milwaukee drew up some statistics of storms and destructions on the Lakes, the Hon Halbert E. Paine prepared a bill we each put our shoulders to the wheel and behold on February 9 1870 the Secretary of War was authorized to carry out this new duty I had spent a year in finding stations, voluntary observers and telegraph facilities, every old classmate or friend of progressive meteorology had helped the new idea.

The work had now as I supposed, passed out of my hands, but there was in reality much more for me to do A letter from the Chief Signal Officer U S A., General Albert J Myer asked for all possible coöperation The officials of the Western Union Telegraph Co offered the Observatory the same free daily weather reports that they had for twenty years been giving to the Smithsonian Institution and the daily press, so I continued temporarily to make and publish the Cincinnati Bulletin, but in a much simpler form and without forecasts This continued until May 10, 1870, when I was married, and the preparation of the midnight bulletin passed over to the officials of the local telegraph office It was continued in this shape until November, 1870 when the tri-daily bulletins of the Army Signal Service began With the help of Mr Williams, who was in charge of the Western Union office, I printed in October 1869, a code of cipher and should have used this code for economy had not the law of February 9 1870 rendered further reports by our stations unnecessary This code was subsequently greatly improved by the Weather Bureau men and particularly by Gen A W Greely, and it is still in use

The manifold duplicate copies and the printed copies of the daily Cincinnati Observatory Bulletin were distributed until the Chamber of Commerce no longer needed to support it then Mr Williams devised a simple form of manifold map that was a great improvement on my original tabular form of daily reports This map was soon adopted by the Signal Service but was itself displaced in turn by the present handsome daily lithographed chart Without the help of Armstrong and Williams and the new manifold method we could not have promptly responded to the needs of our friends By November, 1870 I had gone to New York and prepared to go as astronomer on one of the Panama Canal surveys but I gave this up and should have returned soon to Cincinnati had I not, in December received a letter from General Myer stating that he wished to see me My work with him in the Weather Bureau of the Army Signal Service began January 3 1871 After a month s practice it was decided that my forecast would evidently more than fill the popular expectations and tri daily publications began at once. The term probabilities ' then became official as it had begun in October 1869 and in those days it was appropriate but we have long since substituted the word forecast '

The subsequent development of the service under Generals Myer Hazen Greely and Professors Harrington, Moore and Marvin, may be gathered from their special or annual reports The service has been greatly favored by the hearty coöperation of many men of knowledge, skill and enthusiasm.



The 14-inch, 45-caliber naval gun, mounted on the New York, Texas, Nevada and Oklahoma

The Size of Naval Guns

Are Twelve 14-Inch or Eight 17-Inch Guns to Be Preferred?

By Lieut. (J. G.) Richmond K. Turner, U. S Navy

AT the beginning of the present war England was the only power possessing naval guns as large as 15 inches, the largest calibers mounted by other nations being either 12 or 14 inches We now hear that Germany is building 17 inch guns, that England has 17 and even 18 inch guns under construction and that the United States may abandon the 14 inch in favor of the 16 inch. The question has been raised as to why this country, having built a 16-inch gun some years ago, did not immediately adopt it and discard the 14 inch in order to keep ahead of foreign construction, the assumption being that the largest and most powerful gun must necessarily be the most effective

In an analysis of a subject such as that of effective gunnery we must reject all features that are based on chance and hold to those that will apply in the greater number of cases according to the laws of probability and error For instance, last year after the second North Sea fight, it was very frequently asserted, because the range was very great and one of the few effective hits on the English vessels was in one of the *Lion's* machinery compartments, that the range for modern battle had become so great that no shell could hope to penetrate side armor that therefore the hit in question must have been a "plunging" or falling hit through the protective deck, and that therefore plunging hits were the only ones that could now be effective Opponents of heavy armor protection also seized upon the situation and said that since ranges were now to be so great, we may as well discard or greatly reduce our armor! The fact is that there are no better reasons for either assertion than before this battle occurred, and the reasons that previous to the war dictated the use of guns and armor of a certain character seem to apply equally well now—though this does not mean that we should not take advantage of certain *known* truths, such as the increased range to be expected and the *possibility* of chance hits such as that on the *Lion*

Therefore in what follows attention will be called to the *most probable* events in a naval battle and less attention devoted to merely *possible* happenings. And obviously, we must leave out the question of training because that is one of personnel and we must confine ourselves to material only

Most of the sound arguments advanced for or against an increase in the caliber of naval guns may be grouped under four general heads

1 The number of guns that may be carried

2 The relative destructive effect of two shells of different calibers.

3 The number of hits that may be made with two different batteries in the same interval of time

4 The "life" of a gun, or the number of rounds it may fire before losing its accuracy

A ship's effectiveness of gun fire is measured by its capability of destroying another ship while suffering the minimum damage herself In other words, by the destructiveness of her fire relative to that of the other ship

Suppose we are building two ships of equal size, speed, and armor protection, and on one we intend to mount 17 inch guns and on the other 14 inch guns. Obviously, since the same weight in both ships is to be allowed for ordnance purposes, we can not carry as many of the larger guns as of the smaller Thus if we put four 3-gun 14-inch turrets on one ship we will probably be content with four 2 gun 17 inch turrets on the other This is about the ratio of light to heavy guns usually admitted in discussions as to the relative advantages of two different batteries. We may say then, in general, that if we choose light guns instead of heavy we may have about 50 per cent more of them

Comparison of the 14-inch and 5-inch projectiles

In examining the destructive effect of armor piercing shell against a ship it is apparent that we can put the enemy ship effectively out of action by sinking her or by so disabling her crew and propulsive machinery that our torpedo vessels may sink her In both cases the same result is attained that is, she is destroyed whether we sink her by means of shot holes in her hull below the water line or send so many explosive shells into her machinery compartments from above the water line that she is forced to fall to the rear In the one case destruction is caused by the direct piercing effect of the projectiles and in the other by their explosive effect

It is immediately apparent that there can be little difference between the holes caused by 14-inch and 17 inch projectiles, because in either case so much water is admitted that it would require but few such holes to sink the ship Therefore, from this standpoint there is a distinct advantage in having the greater number of smaller projectiles provided they penetrate the hull

If we examine the explosive effect of the two shells the same advantage holds to a certain extent. A 14-inch shell weighs but 1,400 pounds and a 17 inch about 2,500 pounds, but the effects of their explosion in a ship's compartment are much the same The high order burst of even a 14 inch shell is so terrible, the increase in pressure being so great and the fragments so numerous, that it is inconceivable that any machinery or human beings in the compartment could escape destruction. In other words the 14 inch shell will so effectively put a whole compartment out of commission that there is little use for the extra effect that would result from the explosion of a larger shell. If a 17 inch shell strikes a turret it is more likely to disable it than is a 14-inch, and its effect is decidedly more destructive than the 14 inch when it bursts on the open deck or against the upperworks of the vessel. It is only by penetrating hits below the water line or bursts in the machinery compartments that a ship is put completely *hors de combat*, however, so it must be admitted that it is probable that the destructive effect of a salvo of twelve 14-inch shells is, with equal

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The new 14-inch, 50-caliber gun, to be mounted on the dreadnoughts now under construction

Modernizing Mississippi River Transportation

The New Steel Barges Which Usher in the Revival of Traffic on the Great Inland Waterway

IN the revival of the Mississippi River as an important artery of commerce many contributing factors are to be found, among them the improvement of the waterway by the removal of dangerous shoals, rapids and other natural obstacles, as well as the improvement of dockage facilities by many of the municipalities which border on the banks of the great river We read but a short while ago in these columns of the huge sums of money which are being expended in re-creating the Mississippi River as a great commercial highway

But improvement of water way and dockage facilities does not constitute all that is necessary in the revival of the river traffic Times have progressed, while the characteristic Mississippi steamboats served their purpose well before the network of railways became so dense in the middle west, they are, for certain classes of transportation, inadequate for current requirements Hence the introduction of oil engine driven steel barges is in it self perhaps the paramount contribution toward the restoration of Mississippi River traffic

The perfection of the modern internal combustion engine, which already has served satisfactorily in coastwise and ocean propulsion of vessels, is strikingly brought out by its advent on our inland waterways in the new Mississippi River freight barges the first of which began running between St Louis and New Orleans on April 15th This modern and unique freighter, the first of an ever increasing fleet, is 240 feet long, 48 feet wide and capable of carrying a cargo of about 2,000 tons dead weight The latter is stowed in a structure 200 feet long 40 feet wide and 12 feet high, entirely above and distinctly separate from the hull proper

The cargo of the new steel barge is handled through the agency of an electrically operated traveling gantry crane which can travel the entire distance of the cargo-stowing space The crane has an extension boom that may be projected 68 feet on either side of the barge The lifting capacity of the crane is three tons. The roof of the cargo space is so arranged in hatches that any or all of the roof can be removed, thus facilitating the loading or discharging of freight. The cargo space is also fitted with sliding side doors.

In general construction the vessel is absolutely fireproof; and the hull proper, being rendered additionally water- and air-tight through the subdivision of the main hull into four compartments any one of which may be punctured below the water line without very serious damage renders extremely remote the chances of foundering. But should unforeseen accidents cause leakage in the hull powerful electric bilge pumps capable of discharging 8,000 gallons per minute are installed on board and can be operated at an instant's notice by a switch located in the pilot house While dwelling on the features of the hull it is well to point out to the fact that since space above the deck is provided for the stowing of the cargo, the liability of the merchandise to damage in case of leaks is reduced to a minimum Further, the longitudinal trusses and the transverse bulkheads which are rendered possible on an extensive scale, give the hull a strength and stiffness far beyond that of ordinary river craft.

Forward of the water tight compartments in the main hull are located the chain lockers storerooms, and the crew's sleeping quarters, while the extreme after end of the hull proper is given over to the engines and other mechanical installations The engines, four in number, are rated at 80 horse power each and drive four screws of 51 inch diameter, giving the barge a speed of 10 miles per hour in still water 7 miles per hour against the current and 12 miles per hour running with the current or down stream The engines burn a petroleum distillate of 29 deg Beaumé gravity The fuel tank capacity is 10,000 gallons

Numerous unique ideas are disclosed in the various installations of mechanical devices prominent among which is the bow pump with suction and discharge at port and starboard The pump is electrically driven and by the turning of a switch in the pilot house it can be made to take in water at either side and discharge it at the other as an 8 inch stream resulting in a pull of 25 horse power It is said that this force is sufficient to enable the vessel to be turned against a 40-mile wind A system of tell tale dials is also installed by which the captain of the barge is constantly informed as to exactly how much water he is drawing and other mechanical conditions which are prevailing in any part of the vessel

As will be seen in the illustrations the pilot house and officers quarters are located above the main cargo house amidships The number of the crew is reported to be 14 men all told made up of captain mate two engineers two oilers cook, two wireless operators four deck hands and cabin boy

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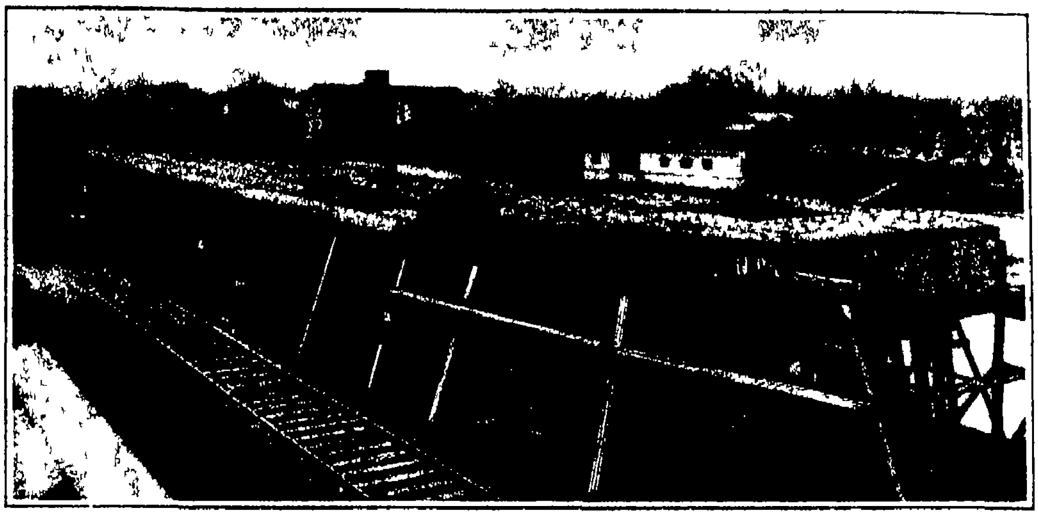
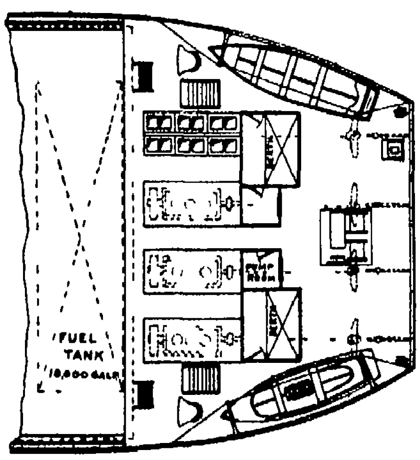
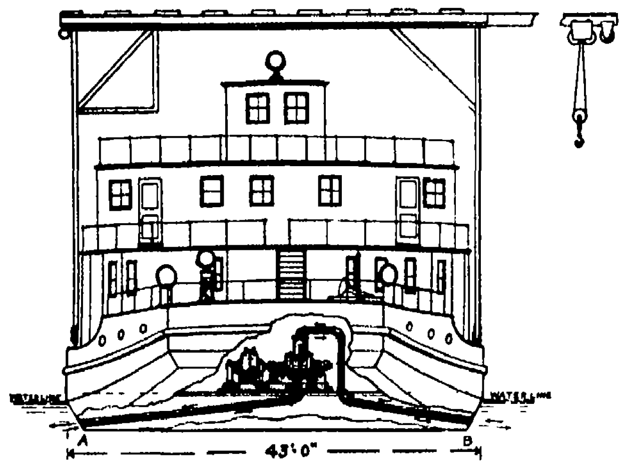


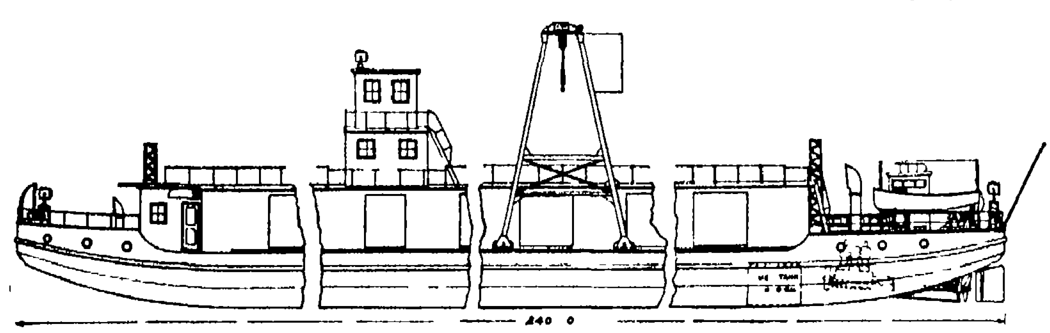
One of the large steel barges being built for the transportation of freight between inland cities on the Mississippi River and its tributaries



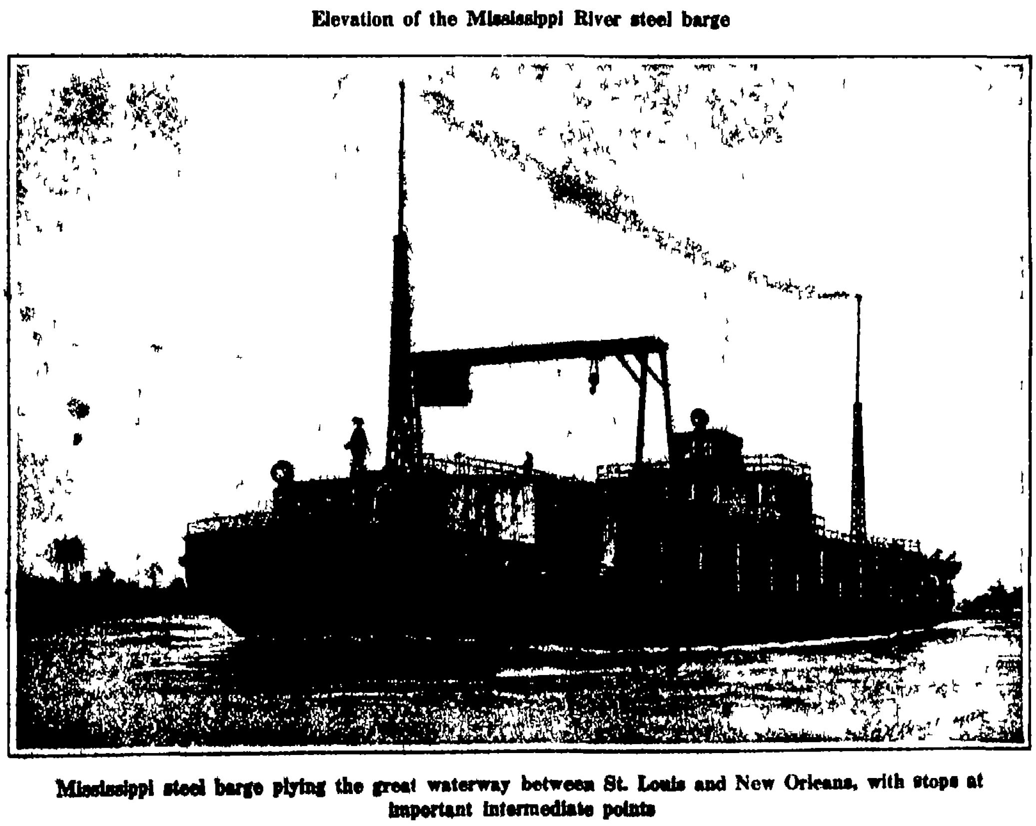
The stern of the barge, showing the location of crew's quarters and engine room



The bow of the barge, showing the arrangement of the traveling crane as well as that of the bow pump



Elevation of the Mississippi River steel barge



Mississippi steel barge plying the great waterway between St. Louis and New Orleans, with stops at important intermediate points

War Game—X

The Trenches—Use of Pick and Spade in Modern Warfare

By Lieut Guido von Horvath

TRENCH warfare is the outcome of extended battle lines It aims at disposing of the possibility of enveloping movements. It is evident that the methods of trench fighting must be different from the battle fought in the open field and its requirements are of quite primitive nature

The spade and the pick ax become more important than the cavalry sabre, the defense depends more on good obstacles than on the possibility of skillful maneuvering The fighting lines approach each other in trench warfare more closely than could have been imagined in any style of fighting since the invention of gunpowder

In place of the free movements of the battle lines in the open and the quick decisions, comes the prolonged struggle of men worms The field of operations might seem to the eye an empty, desolate ground The rattle of the smokeless rifle and the whistle of the bullets would seem to be a strange show were it not for the thunder of guns of all calibres The exploding shells the bursting of shrapnel over a seemingly waste field are the characteristics of the gigantic fights of this type.

Such a fight on a small scale can only develop in a case where, on both flanks, the natural obstacles against an enveloping attack are unsurmountable We have seen such a case in the Ninth War Game, where the Red forces, through the inundation of a large territory, secured their right flank, while the left is protected by Red forces across the Nehaminy River

War Game IX pictured the making of the trenches, the hasty preparation of the defensive lines to hold back superior forces. Now we assume that the Red forces have successfully withstood the attack of the Blues, but they have not been in a position to undertake a sufficiently strong counter attack to turn their passive gain into an active one.

The result of this action must be that the Blues will be forced to entrench on the ground where they find themselves, probably under the fire of the enemy Nevertheless, they must do this, unless they are willing to accept the inability to break through the Red line as a defeat. Very likely the cover of the night will aid the Blue forces in their work of entrenching But whatever happens, the entrenchments must follow, once an engagement has proven that the direct attack against an entrenched position did not have the force the "punch," behind it sufficient to crush the enemy

The character of the entrenchments depends upon the ground on which the troops may make their stand. But, even on difficult ground, the night following the first attempt will give ample time to build trenches of satisfactory strength to give protection to the forces in the firing line.

We observed, in War Game IX, these trenches in the making Now the Blue forces will have to do a very similar work The main difference between the construction of the two lines of trenches will be that the Reds enjoyed a time of peaceful preparation, while the Blues must work under fire. It is easy to realize that this last task is quite a difficult one

Trench warfare has grown in importance since the Russo Japanese war, and to day is far more important than ever before Therefore, it is necessary that we become acquainted with its nature

Construction of Trenches Under Fire

To have a concrete case before us, we shall use the situation of the Blue and Red forces on June 14th, 19—, in the engagement south of Pottstown.

Some time around 1:00 P M, the advance guard of the Blue detachment deployed on the western edge of Pauly Forest and opened fire on the Reds. The targets offered by the well sheltered Reds are rather small and unsatisfactory, promising little damage at the distance. Therefore, the best means to improve the fire effect would be a rapid advance on the part of the Blues. Now, while time is being gained for the main body of the Blue detachment to reach the deploying point and to make ready to assist the advance, the Red artillery will make it hot for the leading elements of the Blues, unless the Blue artillery is able to attract all the attention for the time

In other words, while the infantry is getting into position and preparing for the advance, there will be an artillery duel fought, provided the artillery of the entrenched defenders is discovered early enough in the game to offer a target. Otherwise, the attacking party must turn its artillery on the firing and the reserve trenches.

We shall assume that, at 2:00 P.M., the Blues are in a position to undertake the advance against the Red position Blues, being stronger, will very likely advance on an extended line, with the intention of producing a converging fire effect on the point where the general assault might be expected to penetrate the enemy's lines. The Blues will also occupy such flank ing positions as will enable them to assist the attack ing center portion of the line, by fire of position until the very last moment.

The Blue line commences to advance, and has scarcely covered the first few yards of the effective zone of Red fire when the losses begin to grow appalling Let us assume that the Blues are at a distance of 1,000 yards from the Red position, when the first local commander orders his company to use the entrenching tools after the next rush Then the following things are going to happen

The skirmish line makes a quick rush of about 100 yards forward, the portions of the line to the right and to the left increase the rate of their fire, while the leading company take to their spades, and, lying flat on the ground, each man constructs a shelter for himself as quickly as possible The process is simple, each man throws the dirt forward as he digs himself in. In thirty minutes or less there should be a series of satisfactory trenches to shelter individuals lying prone

One firing unit after another will thus dig itself in, and after this is done the progress of the fight will assume an altogether different aspect. In the place of rapid action a new sort of conflict, resembling siege operations, will develop, until both forces have gathered new strength and energy to undertake a new offensive

We have assumed that the Reds have remained inactive and have been contented with simply holding off the Blues Otherwise a counter attack might have produced an entirely different situation. Therefore, the first energetic advance of the Blues came to a standstill While the opposing artillery are working against the most exposed trenches, and very likely against the enemy artillery, the infantry fire will slacken, and will consist chiefly of firing upon single targets when available.

The night will be a busy one for the Blues, for unless they feel sufficiently strong to make a new attempt to rush the Red trenches, they must strengthen their own positions and prepare obstacles against a possible advance on the part of the Reds. But even in case of an expected second Blue advance, it will be found advisable to prepare the trenches, as in case of a reverse they will be of great value as a rallying point, and will give an opportunity to reform and reorganize.

The more and the better obstacles are placed before the trenches, the easier will it be to defend them. The most effective obstacles are those which cannot be seen at a hundred yards' distance. A thin hedge, for instance, which permits the

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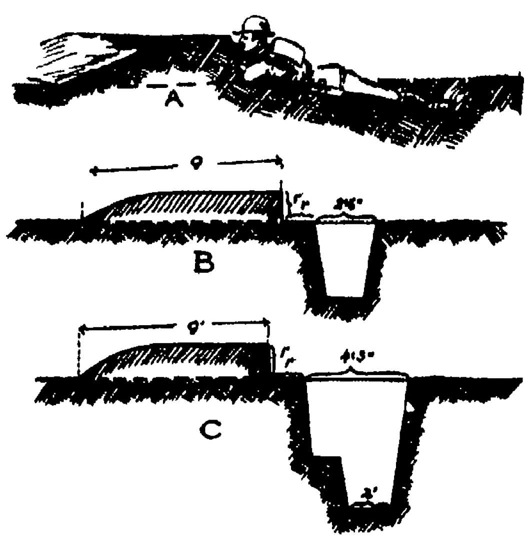


Various types of trenches

A Hastily built trench ready in twenty five minutes. *B* Regular firing trench built in an hour and a half *C* Improved regular firing trench built in three hours

Theory of trench warfare

A Red trenches *B* Blue trenches *C* Barbed wire entanglements *D* Tunnel leading to enemy trench *E* Explosive in mine. *F* Chamber whence sapping was started

Answer to questions 1 and 2 of War Game IX

Emphasizing the Theme in a Player Piano

THE first successful mechanical piano players had no sooner made their appearance than there was an immediate demand, at least on the part of those who possessed the so-called musical ear, for some means of playing the solo, melody, or theme with a stronger emphasis than the accompaniment. Most of us who own or have owned piano players (and this is particularly true in cases where the operator had never learned to play by hand) will remember how the first delight at hearing a musical composition being played directly under one's own control, was quickly followed by a desire to subdue the accompaniment and bring out with clearer emphasis the theme or melody. The inability, in the early players, to emphasize the theme was due to the fact that a uniform tension was used for all the operating pneumatics throughout the scale.

There is probably no element in the player that has been made the subject of so much patient investigation and clever invention as that of theme or solo expression, and, during the past decade, some very ingenious devices have been tried out and placed upon the market with more or less gratifying results.

Broadly speaking, there are four classes of theme-expression devices. In one of the earliest of these, an attempt is made to emphasize the theme by dividing the scale into sections, in each of which the tension of the player-pneumatics is regulated by their own control valves. In this type, the operator endeavors to throw increased tension into that particular section or zone in which the theme notes occur. The obvious defect of the arrangement is that not only the theme notes in any particular section will be emphasized, but also such notes of the accompaniment as also happen to lie in that section.

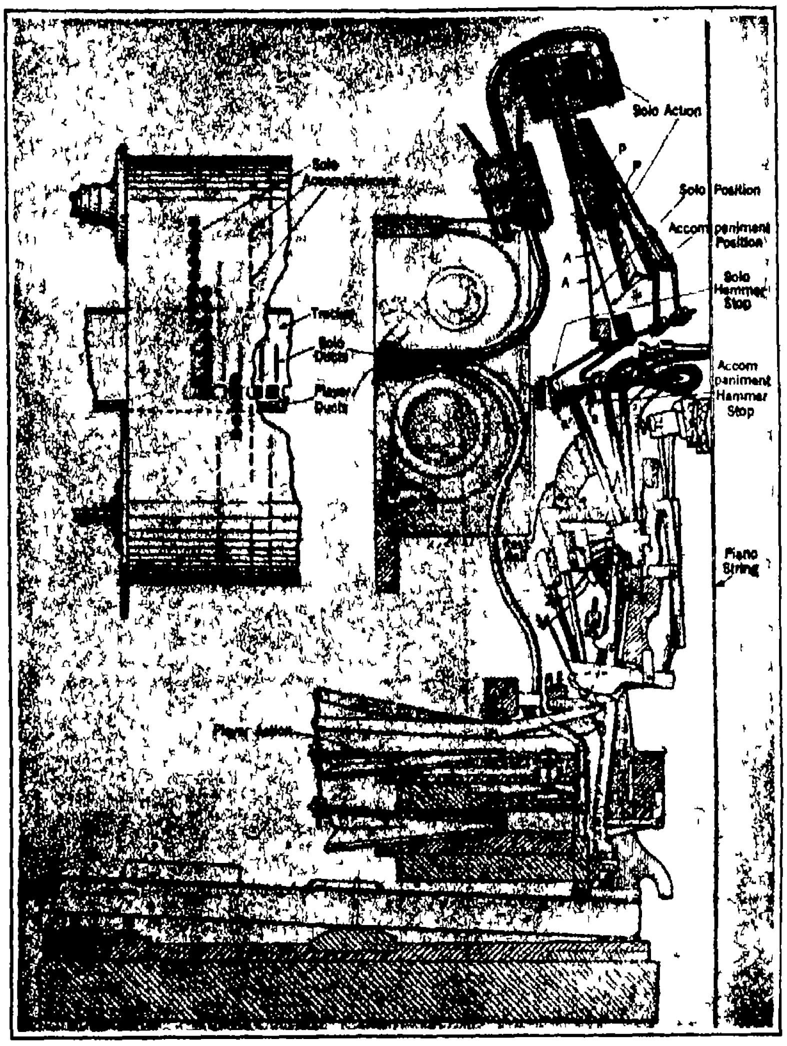
Another type of player is provided with two separate sets of pneumatic actions, each operated by its own tracker bar range, one being used for the melody and the other for the accompaniment notes. If this were carried out literally, there would be a call for a tracker bar with 88 melody notes and 88 notes for the accompaniment, but the difficulty of having a bar and music roll of this length led to the adoption of a bar containing only about 120 apertures.

One of the best known and most successful melody playing pianos secures the desired effect by cutting the perforations in the music roll so that the accompaniment notes are struck first under the normal air tension, and then the air tension is increased in the slight interval before the melody note is struck. The admission of the high tension before the sounding of the melody note is done automatically by means of perforations on the edge of the music sheet.

It will be noticed in the three systems above mentioned that the emphasizing of the melody is accomplished through automatic means for increasing the air tension under which the melody notes are struck.

In the player piano illustrated in the accompanying drawings, the novel features of which have been patented by Mr. Paul Brown Klugh, of Chicago, Ill. the accentuation of the theme or solo is accomplished by controlling the length of stroke of the hammers. The way in which this is done will be understood by a study of the drawings in which the player mechanism is shown in a light tint and the solo mechanism in a darker tint.

The solo action is arranged in the upper portion of the piano case and extends throughout the full length of the hammer scale. Back of the hammers is arranged a series of adjustable hammer stops, there being a stop to each adjoining pair of hammers. The position of these stops, that is to say the distance between them and the piano strings, is governed by the action of the solo pneumatics P, P' and a series of springs A, A'. When the operator is pumping, the solo pneumatics are normally inflated, as shown at P, and the springs A and the hammer stops a are in the positions shown in the drawing. When a solo note is to be struck, the pneumatic is deflated, as shown at P', the corresponding spring is sprung back into the position A' and the hammer stop to which spring is connected is thrown back into the position of full stroke, as shown at a'. The effect of this arrangement is that the hammers corresponding to the accompaniment notes travel, relatively, a short distance before they strike the strings, and the whole accompaniment is played with soft tonal effects, but the hammers which sound the theme or solo notes, traveling through a greater distance, strike their respective strings with greater force and with much louder resulting tone.



Mechanism for intensifying the theme in a player piano

The operation of the solo action is controlled automatically through the music sheet and tracker bar. The tracker bar is provided with the usual apertures spaced to register with the note perforations of any standard music sheet. The tracker bar is also provided with apertures in the shape of narrow slots one above the end of each player aperture as shown. The larger player ducts or apertures open into a series of tubes which lead down to the player action and the slotted solo ducts are connected to tubes which lead up to the solo action.

The music sheet differs from the stand ard music sheet by having note perforations which differ from each other and as the sheet travels over the tracker bar certain note perforations (those for the accompaniment) register only with the large player ducts and others (those for the solo) being wider register with both player and solo ducts.

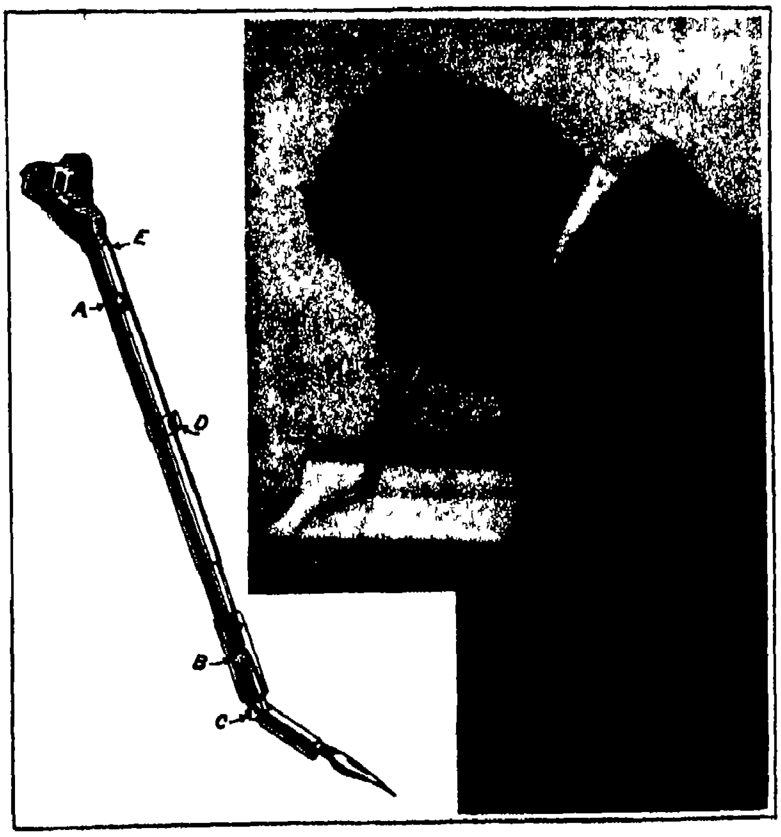
Now as the music sheet travels over the tracker each accompaniment perforation will pass to the side of the slotted solo apertures in the tracker and will pass over the regular player or accompaniment apertures and each of the solo perforations will pass over both the slotted solo and the regular player or accompaniment apertures but when the solo perforations pass over their respective solo apertures in the tracker, they will deflate their respective pneumatics, throwing the respective hammer stops back, and, by increasing the length of stroke of the hammers, will cause said solo notes to be struck with greater force and with resulting louder tonal effects.

Furthermore, in addition to this automatic selection and emphasizing of the solo, the tonal power of the notes may be varied by varying the vigor of the pumping and thus changing the air pressure in the player action. Again the degree to which the solo notes are emphasized may be varied by varying relatively the short stroke and long stroke positions of the hammers.

A Pen that Permits of Writing with the Mouth

By Dr. Alfred Gradenwitz

ADVANCING civilization has entrusted our mouth—originally a merely vegetative organ serving for the introduction of food—with functions of growing complexity. While no longer an offensive or defensive weapon, it has thus become the organ of speech and interpreter of love. The present war, which not only kills but mutilates, puts before it another, most charitable, task enabling those poor cripples who have lost their hands, to put down their thoughts in writing and thus communicate with their friends and fulfill their professional duties as before.



The mouth pen designed by a German dentist and how it is employed

The parts of the mouth pen are as follows. A, B and C are joints so as to allow the pen to be adjusted to the relative positions of the paper and the head of the user. D is a set screw for altering the length of the pen which is effected by means of sliding tubes, while E is a spring to lend flexibility to the writing instrument

The left hand, of course readily assumes such functions as the right one is no longer able to perform and there are cases on record of persons who, after losing their hands, gained wonderful skill with their feet. These cases, however, are the exception rather than the rule, while the simple attachment about to be described endows the mouth even under the least favorable circumstances with remarkable dexterity in operating the writing pen. In fact the special case that suggested the construction of this device was for different reasons especially unfavorable. It was not indeed, a case of an invalid soldier but that of a workman who at the age of 18 without any apparent cause was attacked by growing paralysis of both arms attended with increasing atrophy of the muscles. The late Prof. Joachimsthal, of Berlin a distinguished orthopedist induced a dentist Mr. J. Grünberg to take charge of his unlucky patient and to design for him some suitable writing apparatus.

Since the patient had himself tried in vain to write by means of a pencil introduced between his teeth the dentist followed up this suggestion setting himself to design some suitable mouth piece. As the patient possessed a remarkably strong set of teeth the six incisors could be used exclusively to support the penholder. The mouth piece moulded in accordance with the interior of the mouth embraces about

(Concluded on page 540)

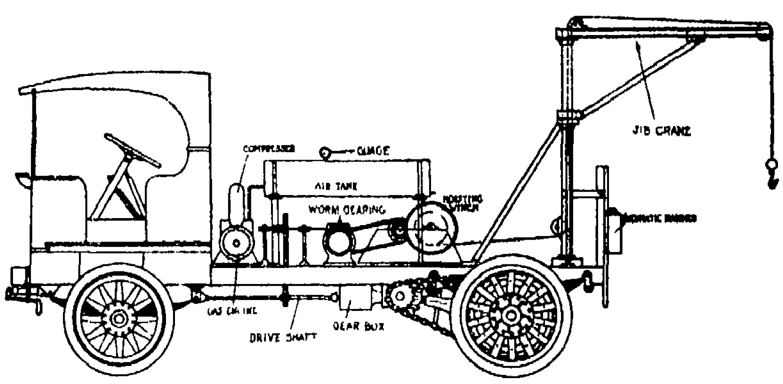
The Motor-driven Commercial Vehicle

Conducted by VICTOR W PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles

Special Truck for Circus Use

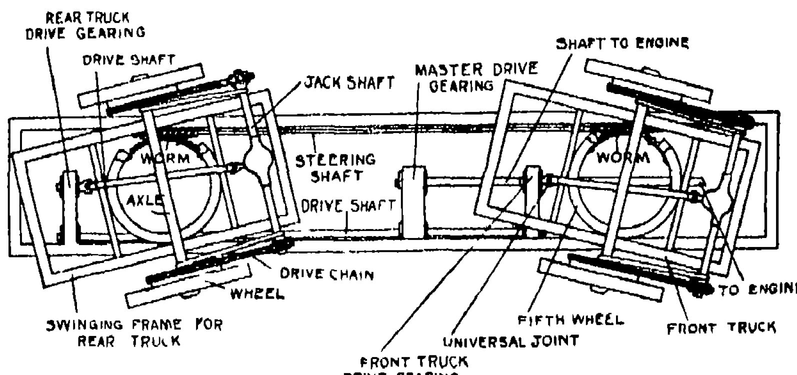
A SPECIAL truck has been contrived to replace or rather relieve the elephants and horses of the circus from the duties of hauling the cage wagons for the animals and perform all of the heavy jobs incidental to the loading and unloading of the mass of paraphernalia necessary to properly present the modern tent show It also materially helps the canvas men in dragging and setting up tents and driving tent stakes The design is the result of the combined efforts of the manager of a Wild West show and a practical truck man The chassis is of three tons capacity All of the devices are carried on the frame in place of the ordinary body and are located back of the cab The main elements are a hoisting winch, a jib crane and a pneumatic stake driving arrangement The hoisting winch is operated from the drive shaft joining the clutch to the gear box by means of a chain to a countershaft This carries a worm and worm gear speed reduction mechanism Another chain connects the speed reducing gear to the hoisting winch driving sprocket and gearing A separate, small gasoline motor and air compressor is placed directly in back of the driver s cab and supplies air to a large storage tank which is carried in a horizontal position above the frame The air from the tank is used to operate the stake driver The reason a separate engine is used to drive the air compressor is that it permits a stake driving mechanism to be operated independently of the truck power plant and of course is an economy because less fuel is consumed in doing the work It will be evident that the winch can be used for either drawing the heavy wagons up the skids to the freight cars, or it can be used in connection with the unloading process The pneumatic hammer materially shortens the time required to drive stakes while these can be easily removed by simply attaching the hook of the jib crane to the stake and turning the power onto the winch This is an interesting example of one of the many uses to which the motor truck is adapted



Three-ton truck chassis fitted for special service in a circus

New Four-Wheel Drive Design

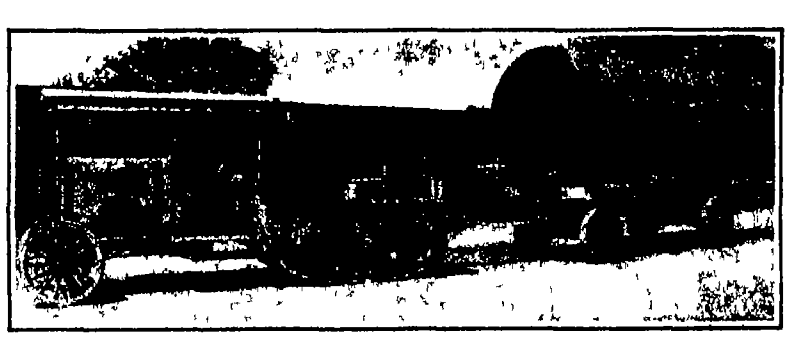
A RECENTLY devised arrangement that permits of driving and steering by all wheels is shown in the accompanying diagram The practical nature of the service rendered by the four wheel drive trucks under the severe conditions of war service both in this country and Europe has stimulated invention along this line In this assembly both ends of the truck are exactly alike as far as relates to the driving arrangement The wheels, axles, supporting springs and the jack shafts used to drive the wheels are carried by independent auxiliary frame members which are attached to the main chassis by ball bearing fifth wheels A steering shaft is supported by one of the frame members this carrying a right hand worm on one end and a left hand worm on the other which mesh with corresponding members attached to the portion of the fifth wheel fastened to the wheel and frame assembly It will be apparent that as the shaft is rotated that the worm gearing will tend to swing the wheels around so that they assume the proper position for negotiating the curves The drive is through the medium of a long shaft carried by one of the frame members this being connected to the propeller shafts by means of silent chain gearing The jack shaft follows conventional design and drives the wheels which revolve on fixed axles A differential gear is provided on each jack shaft and a third compensating gear is provided in the master gear box at the center of the frame to allow for the difference in travel between the front and rear trucks when going over uneven roads Eight hub brakes are provided, four internal and four acting on the outside of the drums. Radius rods are provided to take the driving stresses while the torque is resisted by the springs. In other respects this truck follows conventional practice though the method of final drive is radically different from anything that has yet been offered.



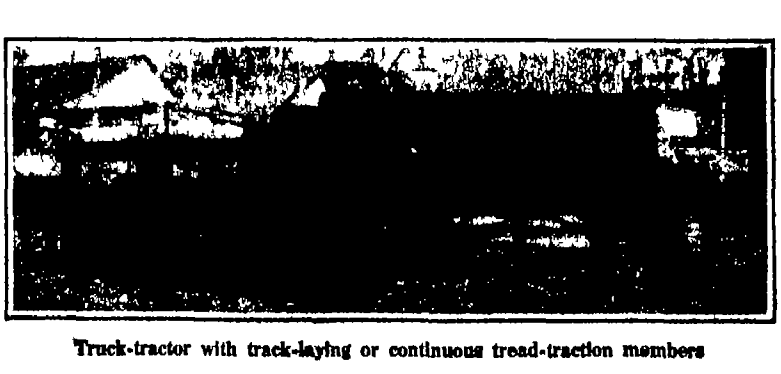
Distinctive four-wheel drive and steer truck arrangement

Track-Laying Truck-Tractor

A TRUCK TRACTOR using driving members operating on the track laying principle which has been extensively tried out in New England lumber camps for hauling logs has been found useful for other heavy hauling work The machine is a distinctive construction inasmuch as it will carry a large load as well as provide sufficient draw bar pull for hauling a heavily loaded train of trailers The machine has almost as much speed as a heavy truck, but in addition has the large drawbar pull of a tractor It will carry five tons on its own load platform It has three forward speeds, respectively two four and six miles per hour and reverse The machine is made in two sizes, a 60 horsepower, which is depicted in the upper illustration, and one of 100 horse-power as shown below it. In a recent demonstration it is said that six trailers weighing 2,800 pounds each, on which 33 tons of scrap iron was loaded, were taken up a 16 per cent grade and that the entire load could be started from a standstill on this gradient, making a pull of 41 tons for the machine in addition to its moving its own weight. Trucks that have been built for the English government have averaged 7½ miles per hour, though it is stated that the six mile speed is plenty fast enough for heavy duty work, as this is about the limit at which heavily loaded trailers can travel over the average country road A strong claim is freedom from tire trouble, as it is said that the treads will last three years with ordinary usage The tread is a patented construction that makes oiling any of the working parts of the tractive member unnecessary This is said to be a point that is exclusive in this machine. This type of tractor has been used successfully in hauling heavy artillery, for which work it is particularly suited owing to its great tractive power



Continuous tread-tractor hauling a heavy load



Truck-tractor with track-laying or continuous tread-traction members

Motor Queries and Answers

F R M writes Will you explain the exact status of kerosene carburetion and inform us if the ordinary forms of carbureters can be changed over to use the cheaper fuel The rapidly increasing cost of gasoline has materially increased our operating expenses and we are thinking of changing over to the more plentiful fuel

Ans It is not possible to use kerosene successfully in a vaporizer that has been designed for use with the more volatile gasoline. A kerosene carbureter must be designed especially with the requirements of this fuel in mind in order to provide means of facilitating sufficiently rapid evaporation to enable the engine to run successfully. Kerosene carbureters are on the market which are said to be practical, though there are a number of practical difficulties that are actual drawbacks to the wide adoption of kerosene It is very difficult to start an engine on kerosene vapor unless some means of preheating the engine and carbureter are provided The usual practice is to start the engine on gasoline and only turn on the kerosene when the parts have become heated

J K J writes Will you please explain why it is necessary to have a different degree of angularity in the V engines of 8- and 12-cylinders?

Ans The cylinders of an 8-cylinder engine are 90 deg apart or 45 deg each side of the engine center line Those of a 12-cylinder engine are 60 deg apart. The reason for this is that in a four-cycle engine an explosion can be obtained in each cylinder only every second revolution. The piston has to move up and down twice for each explosion The crankshaft has to make two turns to receive a power impulse from any given cylinder. In an 8-cylinder engine four explosions per revolution would be obtained and inasmuch as a revolution means covering 360 deg it is apparent that in an 8-cylinder there will be a power impulse every 90 deg of crankshaft rotation. In the V type motors the explosions alternate from one side to the other For example, cylinder No 1 on the right hand block would be followed by cylinder No 1 on the left hand block. As the crankshaft can travel only 90 deg between impulses in order for the pistons to be at the proper point to receive the impact of the explosion, it is necessary for the cylinder center lines to be just 90 deg. apart. In a 12-cylinder V motor the explosions occur 60 deg apart as there are six for each revolution of the crankshaft. It is necessary therefore to space the cylinders 60 deg. apart. A simple rule that can be easily remembered for determining the angle between the cylinder blocks is to divide 360 deg. by half the number of cylinders.

RECENTLY PATENTED INVENTIONS

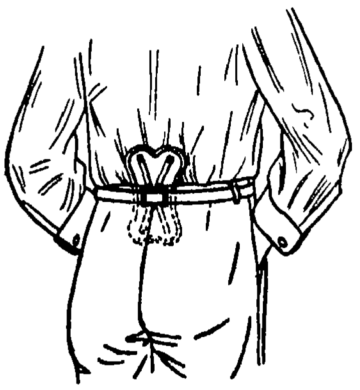
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

KNICKERS DRAWERS AND THE LIKE FOR FEMALES.—OLGA E. BULBY, 7 Burbage road Herne Hill London, England This invention particularly relates to a method by which the flap is normally held in closed position but which can be moved into the open position without the necessity of unfastening buttons or the like and consists in providing the flap with a band normally passing around the waist, such band being made so as to be passed downward over the body in order to turn the flap down

INNER LINER FOR SHOES.—W KREUZER care of Wilson, 410 W 130th St New York N Y This invention relates to liners for wearing apparel and has for an object the provision of an improved liner which incloses the foot and holds the same from contact with the shoe so as to prevent the transmission or absorption of heat from the foot

SPINE ARCH SUPPORT.—E PACKER care of M Packer 2134 Kent St Los Angeles Cal This invention relates to a support for the arch of the spine so as to support the human body from the small of the back to a

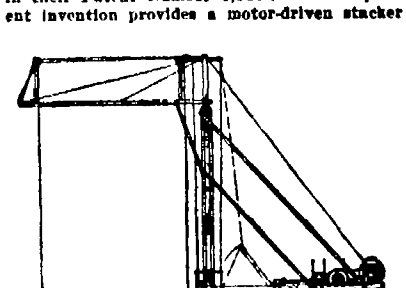


SPINE ARCH SUPPORT

point just above the waist line and thereby give support to the curvature of the spine whereby a person will stand erect with greater ease, walk with more comfort, sit straight and breathe more deeply It is easy to apply and hold in proper position and is of light weight so as not to unduly encumber the person.

Of Interest to Farmers

HAY AND GRAIN STACKER.—J M and J A. HARVEY, Ogden, Kan This invention relates to stackers for hay, grain, straw, leaves and the like and more particularly to certain improvements upon and in connection with the hay and grain stacker described and claimed in their Patent Number 1,113 988 The present invention provides a motor-driven stacker



HAY AND GRAIN STACKER.

which deposits with speed and precision, large loads of hay and grain in the straw at any desired point throughout the entire length breadth and height of the stack, and the stack may be any length desired as material is deposited alongside of but parallel to the line of travel of the carriage of the machine

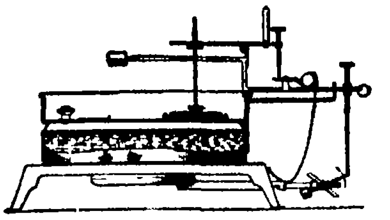
Of General Interest

WATCH BOW MOUNTING.—L S HANSON Eureka, Mont. The improvement provides a watch bow mounting in which the bow has orifices in alignment with each other and through which pins extend for insertion in recesses at the sides of the watch pendant the pins being held against removal by frictional engagement with the pendant at the recesses therein

SEAL.—W L KELLY West 1308 Cleveland Ave Spokane, Wash This invention has particular reference to a car or package seal It provides a device of this character which is preferably made from a single sheet of metal formed into a housing and locking device which, after being locked, cannot be opened without tearing or mutilating the same

BOTTLE CLOSURE.—J R TREVOR 11 E 91st St New York, N Y This improvement relates particularly to a bottle closure and provides a construction which positively seals the bottle It provides a closure formed with sealing material arranged thereon of a pliable nature so as to positively seal a bottle or other receptacle to which it is attached even though the same may be irregular or rough

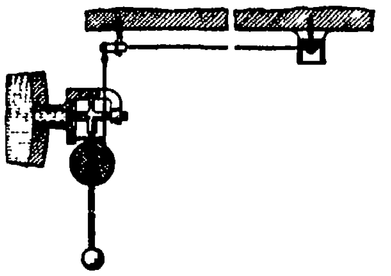
PASTEURIZER.—P MAICAMP care of Mr Charbonnet, druggist, corner of Derbigny and Frenchman Sts., New Orleans, La. The inventor provides a device for use with gas stoves and the like, for pasteurizing milk, wherein mechanism is provided controlled by



PASTEURIZER.

the heat of the milk being pasteurized for cutting off the flow of fuel to the heater when the milk has attained a predetermined temperature He provides a device which may be used in the same manner to cut off the fuel supply when the milk begins to boil, and controlled by the boiling of the milk

AUTOMATIC FIRE EXTINGUISHER.—H W MEYER, 152 William St., Newark N J This invention relates more particularly to a fire extinguisher provided with a nozzle having a controlling valve and arranged to discharge a stream in a predetermined direction and means for operating the controlling valve automatically from a remote point in the di



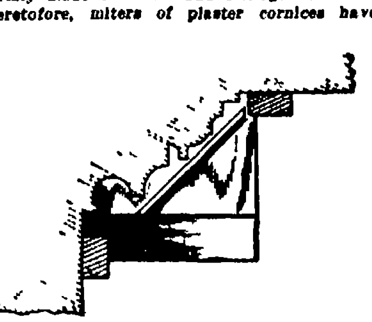
AUTOMATIC FIRE EXTINGUISHER

rection toward which the stream will be discharged from the nozzle Its invention also relates to the aggregation of a plurality of nozzles. It further relates to an automatic valve which comprises a body constituting a fluid passage for the escape of water and having an outlet, a removable closure for the outlet and automatic releasable means gravitationally operable to displace the valve outlet closure.

Hardware and Tools

RAZOR STROPPING MACHINE.—R. E. BROWN care of American Hone Co., Olean N Y This improvement provides means for holding the abrasive materials in a straight path while in contact with the edge of the blade, provides means for accomodating blades of different length and shape avoids carrying the abrasive members past the cutting edge and simplifies and cheapens the construction

TROWEL.—P L FERGUSON, 863 Capital Ave. Ogden Utah This invention relates to plastering tools and more particularly to a trowel whereby a suitable design of plaster cornices or moldings may be readily and uniformly made on walls and ceilings of rooms *Heretofore, miters of plaster cornices have*



TROWEL.

been put in by hand labor but the present invention overcomes this disadvantage by rendering the miter cutting of little or no consideration as the straight work of the tool reduces the price of run plaster cornices to a great extent, making it possible to compete with the stucco plaster cornices of to day

TAPPING DEVICE.—E PERMMI, 329 Union St Brooklyn New York, N Y The invention relates to hand tools and provides a tapping device for the use of mechanics It can be readily carried in the hand by an operator for conveniently and quickly tapping a hole and running the tap out of the tapped hole. The compact form of the device permits its use in places where wrenches and like tools employed for turning a tap cannot well be used.

GREASE GUN.—C H KIRKENDALL, 127 Duane St, New York, N Y This invention provides a grease gun the plunger of which can be driven totally into the barrel without ejecting the contents thereof if so desired It provides a grease gun the length of which can always be maintained at its minimum, whether the gun is full or not.

Heating and Lighting

GAS FIRE STARTER.—H CARDIN, 890 Chester St., Brooklyn, New York, N Y This invention provides an attachment whereby ordinary illuminating gas may be conveyed to and utilized in a fire box for starting the fire in which heavy fuel such as blocks of wood, coal or the like is employed, the device being designed especially for self-support upon one of the grate bars of any usual or ordinary construction.

Household Utilities

FOLDING CHAIR.—J D LAWRENCE, 200 Nassau St., Princeton, N J This invention refers to folding chairs or stools. It provides a design for the manufacture of a chair mainly from tubular metal whereby it will be not only cheaper but stronger than the usual forms of folding chairs. It provides facilities for renewing the fabric seat portion of the folding chair and at the same time prolonging the life of said seat.

SINK COVER.—S A. GODOY Address W Hunt Harris, Attorney, Key West, Fla. The cover is for use with open sinks, closets or vaults, wherein a perforate cover and a seat are provided, connected together and mounted to swing into and out of operative position, and wherein a swinging platform is arranged at the front of the sink, and connected to the seat and cover in such manner that when the user steps upon the platform the cover will swing out of position and the seat will be swung into position while when the user steps off the platform the seat will move out of operative position and the cover will move into such position

FLY TRAP.—J F OTLER, Delray, Fla The trap is for use in catching the fly known as the 'grape leaf hopper, or black fly, that is so destructive of the bean industry in Southern States, and the invention provides a device mounted to be drawn through the field and having means for causing the flies to arise from the ground and the plants, and having means for catching the flies as they arise

Machines and Mechanical Devices

LABELING MACHINE.—G W McCULLEY and G L. MASON Address the former, Valdosta Ga. This invention is especially adapted for labeling cans, as, for instance, cans containing preserved meats, fruits, and the like wherein a hand or power operated machine is provided having gravity operated mechanism for feeding the cans in succession to the machine and wherein mechanism is provided in connection with the feeding mechanism for delivering the cans one by one to the labeling mechanism, and wherein the labeling mechanism is arranged to apply the labels to the cans as they pass by the said mechanism.

PAN CLEANING MACHINE.—T H. KELLER, 24 No Shipper St., Lancaster, Pa. This improvement refers to a machine for cleaning and greasing pans, such as are used by bakers for baking bread. The machine is intended for removing the crust and burnt particles which adhere to the pans, and to scour and grease them preparatory to further baking operations.

CALCULATING MACHINE.—A. W CAMPBELL, 76 Clinton Ave, Clifton N J This invention provides a calculating machine more especially designed as an aid in making up pay rolls to enable the cashier or other persons to accurately and quickly determine the number of bills and coins of different denominations required in paying off the employees.

PNEUMATIC PILE FEEDER.—G BRANDSTETTER and R. FREUND, Hohenstadt, Moravia and Vienna, Austria Hungary This invention relates to automatic pile feeders for printing presses. It avoids the various deficiencies met with in apparatus of this class as heretofore constructed An advantage is in the provision of an apparatus which may be simply and readily mounted in position, and which is independent of the construction of the press, and which can be operated by small pumps running at a higher speed than the press.

SHEET REGISTERING CONVEYER.—A. R ANDERSON, Nannet, New York, N Y This invention relates to sheet conveyers for box making machines, presses, folders, and the like, and has to deal more particularly with means for automatically causing the sheets to be automatically registered or uniformly fed into the machine with which the conveyer is used

TRANSMISSION MECHANISM.—S. P WHITESIDE Box 585, Baltimore, Md This invention relates to transmission mechanisms, having a variable speed control which transmit more power than could be transmitted through the variable speed control directly The transmission mechanism is characterised by a positive drive and a friction drive associated therewith and controlling the variable speed of the transmission mechanism—that is, of the positive drive.

CLUTCH.—S. P WHITESIDE, Box 585, Baltimore, Md. The invention relates to clutches whereby a driving and a driven member can be first slipably connected, to bring the two members to substantially the same speed, then positively coupled It provides a transmission clutch whereby a driving and a driven member can be positively coupled without danger of injury to the parts of the clutch mechanism.

WRAPPING MACHINE.—A. LINKER, 970 Eastern Parkway, Brooklyn, New York, N Y This invention relates to wrapping machines, and particularly to machines designed to sever a bar or other supply into sections and then wrap the sections. It provides a wrapping machine which will fold a wrapper around an article and then fold the ends of the wrapper

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Classified Advertisements

The Difficulties of Railroad Maintenance in Alaska

(Concluded from page 523)

a few hours before the entire mass of falsework disappeared in the grinding break-up of the ice Concrete ice-breakers have thus far sufficed to keep the river ice from carrying out the slender piers, so that neither glacier has advanced to menace the bridge.

A few miles above the bridge, the moraine of the largest glacier, the Miles, dams up the river, forming a natural reservoir in the gorge for 20 miles above the obstruction The line is obliged to follow for that distance the shoreline of this body of water, after which the gorge becomes so narrow that sidehill construction is necessary At mile 130, Chitina, the first town on the line is reached The Copper River is here crossed on a pile trestle nearly a mile in length, and the Chitina River is followed to the terminus of the line

Operation of the line is maintained throughout the year, with a usual schedule of a train a day each way Operation is probably the most regular in winter In summer the story is very different. In August of last year, when the pictures illustrating this article were taken, operation between termini was suspended at one time for over two weeks, and at other times for a shorter interval The water rose 10 feet above all previous marks, and covered the rails for 20 miles above the obstruction The furious currents of the glacial tributaries took out many trestles, and the whirlpools of the main river as appeared when the water subsided had in several places turned the heavy track completely over, as if it had been but a strip of canvas While the lower parts of the line had been under water, forest fires caused by the intense heat were raging along the last hundred miles We found several trestles, one of them ninety feet high, and a thousand feet long, ruined The fire, where it did not destroy the timbers entirely, ate out the joints, and rendered the structure useless A few hours after we left Kennecott on our return, the lake which each summer forms within the glacier, burst, and took out with it 18 bents from the trestle across the stream at the foot of the glacier Later on the return journey we rode on new track around a heavy land slide caused by the thawing of frozen ground on the mountain side Parts of the trestle bridges across the main river are taken out each spring by the ice, and owing to the fury of the current watch must be kept over them every hour in the year

Acknowledgement should be made of the remarkable efficiency shown in the operation of the road Considering the difficulties involved, delay to traffic is very small, and wrecks are almost unknown The road is now operated at a profit, and a short extension will open up the Bering River coal fields, and the petroleum deposits of the Katalla region Over a million dollars worth of copper ore is shipped each month over the road, and thousands of cases of salmon each summer Passengers are transported at a rate of 12 cents per mile.

The Size of Naval Guns

(Concluded from page 580)

accuracy and penetrative power considerably greater than that of a salvo of eight 17-inch shells.

The direct penetrative power of armor piercing projectiles against homogeneous nickel steel armor is usually computed by means of what is known as the de Marre formula, which is:

$$V = K\frac{d^{.75}e^{.7}}{p^{.5}},$$

where V is the striking velocity of the projectile, p its weight, d its diameter, e the thickness of armor penetrated, and K a constant. The same formula is used in the case of face hardened armor by assuming a "figure of merit" of 1.5, or by taking the required velocity 1.5 times as great as that given by the formula.

The velocities of 14-inch and 17 inch projectiles must then be, for piercing the same plate, in the ratio

$$V_{14} : V_{17} = \frac{d_{14}^{.75}}{p_{14}^{.5}} : \frac{d_{17}^{.75}}{p_{17}^{.5}}$$

or

$$V_{14} : V_{17} = 1.154 : 1,$$

the smaller shell requiring 15 per cent more striking velocity than the larger

Furthermore, the larger projectile holds its velocity longer during flight since, by Mayevski's differential equation for the retardation caused by the air

$$\frac{dv}{dt} = -A\frac{d^2}{p}v^n$$

Therefore, if the two projectiles leave with the same velocity the lighter will at once begin to lose velocity faster than the heavier by the ratio

$$a_{14} : a_{17} = \frac{d_{14}^2}{p_{14}} : \frac{d_{17}^2}{p_{17}},$$

or

$$a_{14} : a_{17} = 1.211 : 1$$

Thus, if the two guns have the same muzzle velocity the 17 inch projectile will arrive at its target with the higher velocity, and conversely, if the 14 inch will just penetrate a certain thickness of armor at, say, 15,000 yards the 17 inch should be able to penetrate the same armor at a much greater range

It appears from the above that at very great ranges the 14-inch shells will not be effective except against the upper works of a ship, and that armor will turn them aside much more readily than it will the 17 inch, at smaller ranges however, the greater number of light shells will have a greater effect than the smaller number of heavy projectiles This deduction accords exactly with the observed facts

Certain inaccuracies are inherent in the flight of projectiles and in the aim of naval guns The inaccuracies of flight may be laid to such things as small differences in the weights of the projectile and the powder charge, more or less unsteady flight due to the fact that the center of gravity of the shell may not lie exactly in its axis of rotation, slight differences in the action of the powder upon firing, different wear in different guns, and many other small causes The total effect of all the inaccuracies is an error whose average is nearly the same for all large guns, if the angle of fall is the same Therefore, if the 14-inch and the 17 inch shell have the same angle of fall it is to be expected that we will get 50 per cent more hits with a twelve-gun battery than with an eight gun battery

As the range increases the angle of fall of the 14 inch increases much more rapidly than the 17 inch, since the latter keeps its velocity longer There will be a certain range, therefore, when the probabilities of hitting which depend upon the errors and thus upon the angle of fall will be exactly the same for the 14 inch 12 gun battery as for the 17 inch 8 gun battery The larger shells would now, with an equal number of hits, be much more effective since their penetrative power is so greatly superior There is also a certain range less than the range where the chances of hitting are equal, where the destructiveness of the two batteries would in the long run be exactly equal If we expect to fight our naval battles at ranges less than this certain range the battery of twelve small guns is to be preferred to that of eight large guns, while if we expect to fight our battles *as a rule*, at greater ranges, the large guns will be the more effective.

Naval guns do not fire at a target at sea under the same conditions as do emplaced guns The latter may be aimed by laying them at vertical and horizontal angular distances from some fixed reference point, and when fired will send their projectiles to a certain definite point on the earth's surface, neglecting errors. Naval guns, on the contrary, must, due to the vessel's motion, be aimed by a man some place on board the vessel itself, who must be able to see some part of the target at which he is firing Under the present system of spotting the fall of

shot the spotter is on a platform about 125 feet above the surface of the water, and he must be able to see the waterline of his target. Thus the utmost possible range at which naval fighting may be carried on is limited by the horizon of the eye of a man about 125 feet above the water The distance of this horizon is 25,800 yards, so that about 25,000 yards may be considered the greatest possible range for vessels firing under present conditions

If the existence of a critical range for two batteries, such as that defined above be admitted, then very evidently there must be some certain battery of guns of a certain size, which will be more effective at ranges up to 25,000 yards than any smaller number of larger guns There will thus be no advantage in going to a larger gun but on the contrary a positive disadvantage, since at such ranges as have obtained in the present war the disproportion will be even greater And unless we can be sure of having a faster and more mobile fleet than an enemy armed with even smaller but more numerous guns we can not be sure that he will not close in and defeat us at comparatively short ranges

The limit of *effective* range for a battery from what has been said is seen to be that range at which enough hits may be scored to sink the enemy ship before the ammunition is exhausted The striking velocity of the projectiles must be sufficient to penetrate the armor protecting the vitals of the ship at that range Ordinarily this must be considered to be the side armor since the protective deck armor may only be penetrated by a plunging or nearly vertical, fire and hits of this character are chance hits It will be interesting to compare, roughly, the relative effectiveness of the 14 inch and 17 inch batteries we have discussed at the range limit of 25 000 yards, and to find the weak and the strong points of each

A 14 inch shell leaving the gun with an initial velocity of 2 800 feet per second will arrive at a target 25,000 yards away with a remaining velocity of 1 373 feet per second, and will fall at an angle of 26° 13′ with the horizontal plane The danger space for the side of a ship 30 feet high will be 19 5 yards, and for the whole ship, if her beam is 90 feet, 49.5 yards. The striking velocity will take the shell, in the majority of cases, through 10 6 inches of armor, using a "figure of merit" of 1 5 in the de Marre equation

A 17 inch shell, on the other hand, with an initial velocity of 2,800 feet per second will strike 25,000 yards away with a velocity of 1 478 feet per second, which is sufficient to carry it through 12 2 inches of armor The angle of fall will be 22° 14′, and the danger space for the 30-foot side of the ship will be 24 yards and for the whole ship 54 yards

If the errors in the range vary directly with the angle of fall, which is a rough approximation, a 14 inch shell would have 84 per cent as good a chance of hitting as a 17 inch if the danger space were the same But since the former has a danger space of 49 5 and the latter 54 yards, the 84 per cent must be reduced (again approximating) by the ratio of 49.5 to 54 This gives 77 per cent for the 14-inch But since there are twelve 14-inch and only eight 17 inch, we might actually expect 1 16 hits of the former to one of the latter

It is immediately apparent that the 17-inch battery has a marked advantage over the 14-inch at a 25,000 yard range, since the latter will very seldom penetrate the protective armor, and its advantage of 16 per cent more hits is lost because so few would be effective

It is not until the range has dropped to 18,500 yards that the 14-inch will be able to penetrate 12.2 inches of armor, and since armor protection of at least 12 inches will ordinarily be encountered on heavily armored ships the limit of range at which the 14-inch will be effective must be considered to be between 18,000 and 20,000 yards. And it must also be admitted that, owing to the increased probabilities of hitting at such a range, the twelve 14-inch guns will be more ef-

fective than the eight 17 inch guns at less than about 18,000 yards.

In the calculations above it has been assumed that the larger gun will have the same muzzle velocity as the smaller Such an assumption, however, may be found to be false when the work of designing the larger gun is undertaken As a general rule large calibers do not have as great a muzzle velocity as small, because of the great influence the bore pressures and powder chamber volumes and thus velocity, have upon the life of guns. If we are content to have our guns wear out quickly we can have a high velocity, but if we consider it important to have a gun that will last through many engagements the matter must be more carefully considered Then if the large gun is assigned a lower muzzle velocity than the small gun, the advantage of the 17 inch gun at ranges in excess of 20,000 yards may nearly, if not quite disappear In that case an even larger gun would have to be mounted to be effective at 25 000 yards

The "life" of a gun is measured by the number of rounds it will shoot accurately After a certain number of fires, which is practically constant for all guns of a certain type, the flight of the projectile will be erratic The gun must then be withdrawn from service The principal reason for this wear is the eroding action of the heated powder gases flowing over the metal of the bore and to make the gun serviceable again it must be re-lined In large calibers the walls of the gun will conduct away less heat proportionately than in small calibers and thus the eroding action of the gases is much greater in the former The life of an infantry man's rifle, for instance, is several thousand rounds, while the life of a large naval gun is only a few hundred rounds If the muzzle velocity and thus the powder pressure and temperature of combustion, is lowered the erosion of the bore will be smaller So there is always an excellent reason for hesitating to adopt a larger gun with a very high velocity, particularly since the life can not be always accurately predicted

Few of the elements that have been here considered are mathematical and most of them must be judged according to the ideas of experienced men One artillerist for instance may hold that a shower of light shells will be best since it will quickly disable an enemy through putting his guns out of action another may believe that it is best to attempt to sink the ship by shells penetrating the armor and exploding inside Others base arguments for or against larger calibers on the single premise better speed than the opponent. The first of these would use speed to stay out of the enemy's range and, with heavier guns slowly sink his vessels, the second would rather have many light guns and by using superior speed close with the enemy until his heavier guns were at a disadvantage If we could have as many heavy, high powered guns and with as long a life, there would be no question of choosing lighter guns. But if we reduce the muzzle velocity considerably, and have fewer of the heavier type, careful and deliberate judgment must be exercised to determine upon which side the balance inclines.

Modernizing Mississippi River Transportation

(Concluded from page 531)

In the matter of appliances for protecting the boat against accident the Mississippi steel barge is unusually complete The protective measures adopted for the hull have already been discussed. The vessel carries 2 000-pound anchors at bow and stern, and by the aid of powerful electric winches these can be used to haul the boat off if she runs aground A gun which can shoot a line 1,750 feet, in design not unlike those employed in the life-saving service is also provided The barge carries two small boats one, a 20-foot launch capable of 22 miles per hour speed, which, by means of the traveling crane, can be lowered into the water in two minutes' time, the other, a rowboat of conventional type.

The barge is equipped with a powerful wireless telegraph set that permits of communication at any time with the offices in St. Louis and New Orleans. The aerial for the wireless installation is elevated on two telescopic masts which can be lowered when passing under bridges. The wireless installation is not intended to serve merely as a means of summoning assistance in case of disaster it plays an important rôle in the everyday work of the barge namely, to enable the captain to report regularly to the offices regarding his position, speed, the weather, etc, as well as keep the accounting department informed as to the freight on board the boat before its arrival It is also possible by this means to make the necessary arrangements with the roustabouts at the next landing place so that the minimum of time will be consumed in the unloading operations

The electrical equipment of the vessel is elaborate Current is supplied by an electric generator driven by a silent chain from one of the engines When the boat is not in motion a clutch on the propeller shaft is thrown out and the engine continues to drive the generator without turning the propeller Aside from furnishing current for the lights and the three powerful searchlights—one at the bow one at the pilot house and one at the stern each controlled from the pilot house and representing a combined candlepower of 18,000, the generator supplies power for the dozen or more motors that are used for different purposes on board Current is also used for all the heating and cooking on the barge, since no fire is allowed on board

A Pen that Permits of Writing with the Mouth

(Concluded from page 533)

one half of the crowns of the lower teeth whereas the upper ones only rest on it with their lingual surfaces, thus leaving the edges and labial surfaces disengaged In fact, the mouth piece remains fixed to the lower teeth, even when the mouth is open

A straight and rigid penholder obviously would have been inconvenient, besides straining the muscles of the neck and jaws Mr Grünberg therefore designed a penholder comprising three joints, one of which—the central one—was fitted with a spring endowing it with sufficient elasticity The penholder is made up of two tubes sliding inside one another, their total length being adjusted by means of a set screw The nib is preferably one with rounded or ball point and can be replaced by a pencil at a moment's notice The paper is kept in position by a rectangular brass ruler covering its left hand and upper edges.

Systematic training was, of course, required to acquaint the man with the use of this arrangement beginning by simple dashes, he proceeded to the tracing of separate letters and words. After getting through about half a dozen copy books as used in schools, he was able to write with the utmost ease and as readably as few of his class with their right hands

War Game—X

(Concluded from page 532)

fullest fire effect and still hides the barbed wire from the eyes of the approaching enemy, is a very effective arrangement. The entanglements are placed at a distance which permits the fullest use of the rapid fire rifle. Entanglements with mechanical devices enabling the defenders to pull them up into shape just in time have proven of great value in defensive warfare

Once the belligerents have settled down to trench war, the simple trenches are improved and many other means are employed to strengthen the defensive lines In addition to the barbed wire entanglements. These means vary a great deal, but in principle they are similar to those used in the preparation of regular fortifications, They include ditches, abattis—built up of trees with the branches left on and sharpened, wood or iron "fraises," "trous-de-loup" holes with spikes in them and every imaginable device which will create an effective obstacle. [illegible]

all, a good barbed wire entanglement is by far the best.

The effect of these obstacles is very great, especially if the attacking party should encounter them unexpectedly. The assaulting force is brought to a standstill at close range, perfectly exposed. That this means tremendous losses is quite evident.

Now we can consider the effect of artillery fire upon these defensive preparations and how to guard against this artillery fire.

Trenches with a perpendicular wall and of sufficient depth will offer excellent protection against projectiles flying horizontally, such as rifle and machine gun bullets. When a searching fire of shell or shrapnel is considered, these same trenches will be found lacking in protection.

The shrapnel is a cleverly arranged miniature gun in itself. This is fired at a range of several miles, and bursts, if well timed, about 30 feet above and from 20 to 75 yards in front of the target, scattering at its burst about 250 bullets over the surrounding ground. The angle of fall is such that many of these bullets will find their way into the trenches. To protect the men in the trenches from this fire overhead cover must be provided. This cover is formed by placing beams and logs over a portion of the trench and covering with sufficient thickness of earth to stop the projectiles. As a matter of course, these shelters must be made as invisible as possible, so that they may blend with the surrounding landscape and resist the searching eye of the artillery observer.

We shall not go into details regarding howitzers just now, for our present problem will not deal with heavy calibre guns.

There are two chances to work on trenches under fire. The simpler one is during the night under cover of the darkness. The second is to work under cover of heavy fire by supporting troops directed on the enemy lines to hold the fire down or to render it less effective.

All these defensive preparations lead to no decision, and since every moment lost while at a standstill is a waste from a strategical standpoint, it is evident that trench warfare is a very expensive undertaking.

The Means of Reaching a Decision in Trench War

Once two forces, under conditions given in the last War Game and this present Game, have settled down to the modern trench war, there will be a singular situation established, which will appear entirely different from the field operations so far considered. To achieve success one side or the other must make an advance. This must be done by slow stages. Should there be a distance of 1,000 yards between the opposing first line trenches the approach can be made by constructing zigzag trenches in the direction of the enemy, exactly like a siege operation. At intervals branches are laid out as regular firing trenches, approaching closer and closer to the enemy, and thus constituting what is termed a parallel.

There is also the method which the Japanese introduced. Men carrying steel shields rush out of the firing trenches and start a new trench in front of the firing line. As soon as shelter is made, other men rush out and occupy it and strengthen the new line. This work is done under cover of the fire of the infantry and artillery.

These processes continue until the trenches are so close together that this sort of operation becomes impossible.

When our Red and Blue trenches have approached to within one hundred yards of each other a new phase of the fight ing must be considered. The chief arm for the defense is now the machine gun while the attackers rely upon the bayonet, the butt of the rifle and the hand grenade.

Night attacks, which are very rare in open field fighting, are commonly used in trench warfare. In operations of this latter sort the occupants of one trench know exactly where the enemy is located,

and there is therefore no danger of mistaking their own troops for those of the enemy. For this reason these night attacks will be frequent. Since the tactics of trench war are too new to have their own book of instructions or regulations, we may give our own names to the three different attacks now in use. The small surprise attack, the larger prepared attack and the mine attack.

The first is self explanatory. The second means that by concentration of heavy artillery fire on a selected section the defenses are either breached or destroyed, and the defenders are either killed, driven out or too badly demoralized for an effective resistance. That section is then stormed by as large a force of infantry as can be massed for that purpose. As soon as the assault is successful, the *artillery and the infantry*, which have assisted the assault by their position fire will shift their fire to establish a curtain of fire in front of the assaulting line, to enable them to hold the newly won positions. Connecting trenches are constructed with the greatest possible speed. When this is done, the trenches of the *new position can be considered as consolidated* because from this time reserves ammunition food etc can be brought up to the new line.

Every such advance however, will expose the flanks of the advanced trenches to the enemy fire and for this reason it is very difficult to hold such positions.

The mine attack is a feat in military engineering. It is very simple and at the same time difficult and dangerous to carry out, both for the underground workers and the attacking party on the surface.

A land mine is a mass of buried explosive sufficient when exploded to blow up a considerable tract of ground with everything on it. The aim of the engineers the sappers is to place such a mine under the enemy trenches and then blow it up. This *necessitates the digging and* timbering of a narrow tunnel straight to the enemy trenches. When the proper distance has been reached a mine chamber is built, the mine is placed, the sap bend is banked tight with bags of earth backed up and reinforced with timbers, to be sure that the force of the explosion will be directed upward and not back through the tunnel. The mine is then ready to be exploded by the prearranged electric wiring and spark device. When the time for the mine attack has arrived the soldiers who are to form the attacking party are in readiness in the firing trench. The engineer officer presses the button and a section of the enemy trench is thrown into the air. The waiting attackers charge and occupy the crater.

The consolidation and holding of the crater is entirely dependent upon the assistance given by the artillery.

The accompanying sketches will explain this method of modern fighting.

Developments and Situation

At 3 30 P M the Blue forces, after severe losses established themselves in the cemetery east of Pottstown. Thereupon Brigadier General I G ordered a general advance against the small woods at the fork of the roads. To accomplish this he ordered *forward* the main infantry reserves from their position on the western edge of the forest. The cavalry was brought up to a position in readiness on the Eden Norrisville road.

At 3 50 P M the forward movement reached the line of the railroad and the advanced trenches of the Reds. At this point they came under heavy fire from the Red battery in position near Pottstown and had to take severe losses. This fire, combined with that of the Red infantry, forced the Blues to entrench.

The Blue cavalry was brought back into the cover of Paoly Forest.

At 4 10 P M General G of the Red forces received orders from his headquarters to remain on the defensive.

By nightfall the Red and Blue forces had entrenched about 600 yards apart.

Questions

Question 1 What sort of an order will Captain B give to his company after he has approached to within 200 yards of the cemetery and is ready to assault the Red platoon holding the position?

Question 2 Having driven the enemy from the cemetery, what will happen? Will Captain B issue an order?

Question 3 General G follows the development of the combat from the tower of the City Hall. He sees heavy Blue reserves debouching from Paoly Forest. What will be his decision? How will he put his order into execution?

Question 4 The Blue detachment has a machine gun platoon. Where could the best use be made of them?

Question 5 Issue an order to establish the Blue entrenchments. This order is to be issued at 9 00 P M.

Answers to Questions in War Game IX

Question 1 The range is exactly three miles. This would mean exactly 5 280 yards, which is a distant range for the Goat Hill battery. The other battery on Hill 50 is slightly over two miles from Ash Inn. The distance being 3,700 yards, is well within effective range. See the batteries on the map.

Question 2 See map.

Question 3 The order given by the Blue advance guard commander will be as follows.

We will attack the enemy's position in our front

The First Battalion will be the firing line and will advance in the direction of the small patch of woods

The Second Battalion will be the support and will follow behind the center of the firing line

I will be with the support.

Question 4 As soon as the Red artillery observes the enemy on the edge of the forest, shrapnel fire will be directed against them. Knowing the exact range this fire ought to be very effective. Also, the infantry will open fire when ever good targets offer themselves. The range is about 1 200 yards.

Question 5 The squadron has returned to Pottstown via the railroad bridge. It will be held in readiness with the reserves.

Question 6 The squadron was fired upon by enemy patrols which were at that time in Paoly Forest.

Question 7 The omission of the question of communication with the Red division in the north is an error. It was also an error in a former order in the VIII War Game. But if the highest commander omits to provide for communication in his order the subordinate commander who commands the element of the left flank of the line must send out a left flank patrol, which would establish the connection automatically.

The next War Game will deal with the defense against an enemy landing party.

Industrial Preparedness for Peace

(*Concluded from page* 520)

Results Obtained

When the standards in the Calendering Department were established, the average efficiency was about 62.0 per cent. This efficiency gradually climbed to 100 per cent, and after a period of three years had reached 110 per cent. When our standards were exceeded by 10 per cent, it meant that our allowances for delays, etc, were more than ample, and the creation of habits of efficiency permitted the men to attain excessive efficiencies.

Table Showing Total Output of Coated Calendering Dept (for 1 yr) for Varying Efficiencies with Varying Costs

Efficiency	Output (lbs.)	Labor Costs, including Bonus	Burden	Total Cost	Cost per lb. (in cts) inc. Bonus: Labor	Cost per lb. (in cts) inc. Bonus: Total
63	21,800 000	$33 950	$55 200	$89 150	107	280
66 2/3	33 800 000	33 950	55 200	89 150	100	264
80	40 500,000	35,200	55,200	90 400	087	223
90	45,500 000	37,300	55,200	92,500	082	203
100	50,600 000	40 700	55 200	95 900	080	190

What did this mean to the paper manufacturer? It meant an increase of 80 per cent to 90 per cent increase in production per labor unit, at the same over head cost per day, or a corresponding reduced cost per unit of output. It meant an aggregate annual saving of $23,000 under 80 per cent efficiency, or of $45,000 under 100 per cent efficiency. What did it mean to the worker? It meant better material, better machines, better maintenance, and an average increase in wage of 30 per cent. These conditions permitted the manufacturer to manufacture a better paper at the same price, or the same paper at a reduced price, and thereby meet competition with a distinct advantage. That is Industrial Preparedness for Peace.

NEW BOOKS, ETC.

THE PRINCIPLES OF HEALTH CONTROL. By Francis M Walters, A M. New York D C Heath & Co., 1916. 8vo., 476 pp., illustrated.

Unusually good is this textbook on physiology and hygiene, it has an unique and striking arrangement of material, based upon the different sources of health control. We learn of this control through exercise and posture through adjustment in foods and the avoidance of harmful substances, through elimination through nervous conservation, and through the mind finally the defensive and offensive methods of germ fighting are set forth, and the part that environment, the physician and the law plays or should play in the evolution of individual and national well being. Much emphasis is laid upon corrective measures, since modern life is merciless to the man who ignores such measures. Interesting diagrams illustrations, and tables abound throughout the work each phase of the subject has been placed upon the basis of cause and effect, and guesswork has been largely eliminated.

"JAMES NORRIS" By Albert Pyrmont. New York C Regenhardt, 1915 8vo, 560 pp

The story of this novel is a chapter from the Arabian Nights, modernized, but unexpurgated. Between the acts proper are interpolated reams of semi serious discussion in which the warring nations are regulated law is revolutionized, sex is expounded health is preached and the Scriptures are reconstituted. Much of this reasoning runs in shallow water, some is channeled through rock at times it is Shavian in its paradox. With all the faults of a first work and with not a few peculiarly his own the author shows marvellous scope and amazing industry. Most readers will attain the end, albeit by a skipping process which the author himself suggests.

THE WIRELESS TELEGRAPHIST'S POCKET BOOK OF NOTES FORMULAE AND CALCULATIONS. By J A Fleming M A D Sc, F R S. London. The Wireless Press Limited 12mo, 347 pp, illustrated. Price, 6s net.

In the practical calculations connected with radiotelegraphy a handy compilation of formulas and tables is more than a mere convenience. It is a necessity. Such a compilation is the manual put out by Dr Fleming of the University of London who already has to his credit numerous works on electrical subjects. His first chapter refreshes the memory of the student or operator with just that mathematical information which furnishes the *working tools*. *Most of the succeeding data is* based only upon arithmetical principles, but the final chapter provides logarithms and trigonometrical tables, and tables of squares, cubes square roots and cube roots. While some few pieces of apparatus are pictured and briefly described, for the most part the book leaves this kind of instruction to the treatises and concentrates its effort and its limited space upon the most useful and important data called for in connection with alternating high frequency currents and radiotelegraphic work. Its convenient form, its accuracy, and its practical offerings should make it popular with the craft.

INDUSTRIAL ORGANIZATION AND MANAGEMENT. By Hugo Diemer, B A., M.E. Chicago LaSalle Extension University, 1915. 8vo, 291 pp, illustrated. Price, $2

Here is summarized and illustrated those principles which have come to be recognized *as the essential elements of the new industrial efficiency*, from the broad fundamentals of sound organization, satisfactory location, and well planned buildings and equipment, to actual operation in all its branches—buying, receiving and storage of materials, the planning of finances, sales, production, work, and employment, cost determination, distribution of expense, and standardization. The subject of scientific management is then taken up, time and motion studies and wage systems are considered and employment problems are solved. Diagrams and charts are displayed in profusion the very latest methods of motion study such as that which photographs the movements of an electric light attached to the hand of the workman, are explained; in short, the volume is a complete exposition of the latest practice, methods, and devices used to increase both quality and quantity of output while at the same time improving working conditions for the individual. [illegible]

New Lubricant resists heat-prevents rapid formation of solid matter in your crank case

High temperatures in your automobile engine turn a large part of ordinary oil into black solid matter—your car's greatest enemy. This new lubricant prevents rapid sedimentation, protects metal surfaces, reduces expense

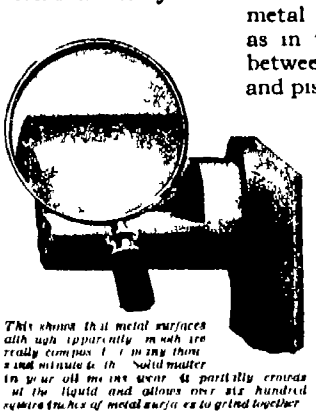
Ordinary oils break down under the terrific heat of an automobile engine after a few hours' use A large part of the oil forms black sediment

The sediment is destroyed oil—heat has killed all lubricating value in it

This solid matter in your oil means wear in your engine

The polished surfaces of bearings and cylinder walls appear smooth to the naked eye, but a magnifying glass will show you that even the finest surfaces are rough and consist of sharp points and depressions

When the microscopic teeth of these surfaces are rubbed together they are broken off worn down The thin film of oil which forms a nearly frictionless cushion between metal surfaces such as in the bearings, or between cylinder walls and pistons —is all that prevents your motor from seizing and destruction As long as the film of oil thoroughly covers the metal to metal surfaces, the motor will run without excessive wear, but as soon as the oil is turned into solid matter the microscopic teeth begin to grind, and friction, the greatest enemy of your engine, does its deadly work



This shows that metal surfaces although apparently smooth are really composed of many thousands of minute teeth Solid matter in your oil means wear It partially crowds out the liquid and allows over six hundred square inches of metal surfaces to grind together

How Solid Matter Damages Your Car

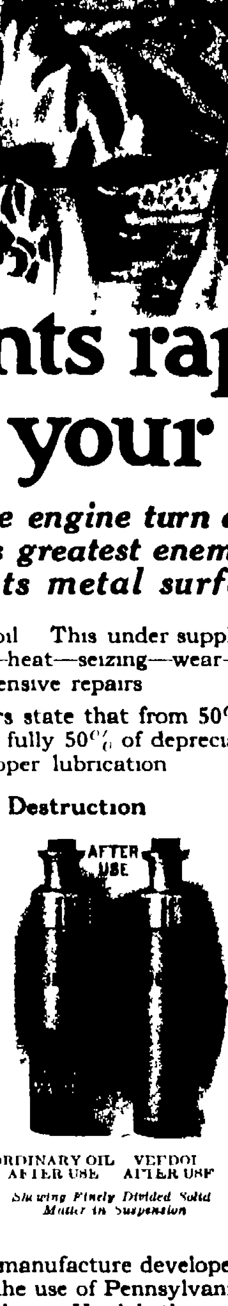
The black solid matter formed by ordinary oils prevents the liquid from reaching the friction points where it is needed This does not mean that the sediment clogs the pumps or pipes, although that trouble may occur It means that the sediment which is inactive or negative partially crowds out the remaining liquid oil This under supply of oil causes friction—heat—seizing—wear—loss of power and expensive repairs

Automobile engineers state that from 50% to 75% of repairs and fully 50% of depreciation are due to improper lubrication

Relative Oil Destruction

The contents of the two bottles shown illustrate clearly the relative durability of ordinary oil and of Veedol, the new lubricant that resists heat Veedol deposits only a small fraction as much sediment as ordinary oil

Ordinary oils are unstable and therefore unserviceable because of non heat resisting chemical structure



ORDINARY OIL AFTER USE — VEEDOL AFTER USE

Showing Finely Divided Solid Matter in Suspension

Special processes of manufacture developed by this company and the use of Pennsylvania paraffine base crude oil give Veedol, the new lubricant, its unusual chemical structure, and its remarkable heat resisting ability

Make This Road Test

Remove the drain plug from the lowest part of your motor crank case and allow all old oil to run out Replace the plug fill the sump up to correct oil level with kerosene and run the motor slowly under its own power for about thirty seconds, to cleanse the interior Then draw out all kerosene replace the drain plug and refill with Veedol

The exact amount of fuel and oil in the car should be recorded and a reading of the speedometer taken before starting Then let a test be run over a familiar road including steep hills and straight level stretches, for any distance up to five hundred miles or more

You will find that your motor has acquired new pickup and hill climbing ability due to the maximum mechanical efficiency made possible through Veedol.

You will find your mileage on both gasoline and oil increases You will reduce your carbon trouble Your motor will have more power

What It Means In Actual Saving

The average mileage of all cars is conceded to be 6000 miles per year and the annual cost of operating the typical or average car is estimated by an expert statistician to be about $416 per year Depreciation, repairs and gasoline come to about $268

Solid matter in your oil means friction and wear friction and wear mean expense expense varies in direct proportion to the amount of black solid matter formed by the oil.

Veedol prevents rapid sedimentation and saves you real money on these items of expense The records of taxi cab companies bus lines and large corporations that use cost accounting show that Veedol should save you from $50 to $115 per year on gasoline repairs and depreciation In addition to these savings your lubrication bill itself will actually be smaller

If you are interested in saving money you will be interested in making your own tests of this remarkable new lubricant

Where You Can Buy Veedol

Progressive dealers everywhere have secured Veedol and can supply you Look for the orange and black Veedol sign If, for any reason you cannot get Veedol at once write direct to the Platt & Washburn Refining Company By return mail you will receive a copy of the book, free, and the name of the dealer who will supply you.

PLATT & WASHBURN REFINING CO

1820 Bowling Green Building — New York

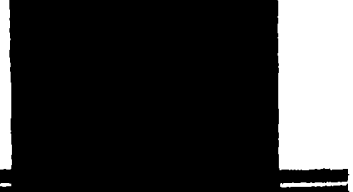
NEW 88 PAGE VEEDOL BOOK FREE

Write for the new Veedol book "The Lubrication of Internal Combustion Motors.

This book explains the A B C s of refining and finishing It gives full information regarding the laboratory and practical service tests. It describes and illustrates all types of lubricating systems used in automobiles motorcycles motor boats tractors, etc It contains a fund of useful information and scientific facts. 88 pages profusely illustrated in colors.

WRITE TODAY

Veedol is supplied in one-half gallon one gallon and five gallon sealed cans 15 gallon 28 gallon and 53 gallon steel drums and in 28 gallon and 50 gallon white oak barrels A special pouring device is supplied with each metal container Guaranteed when sold in the original package



SCIENTIFIC AMERICAN

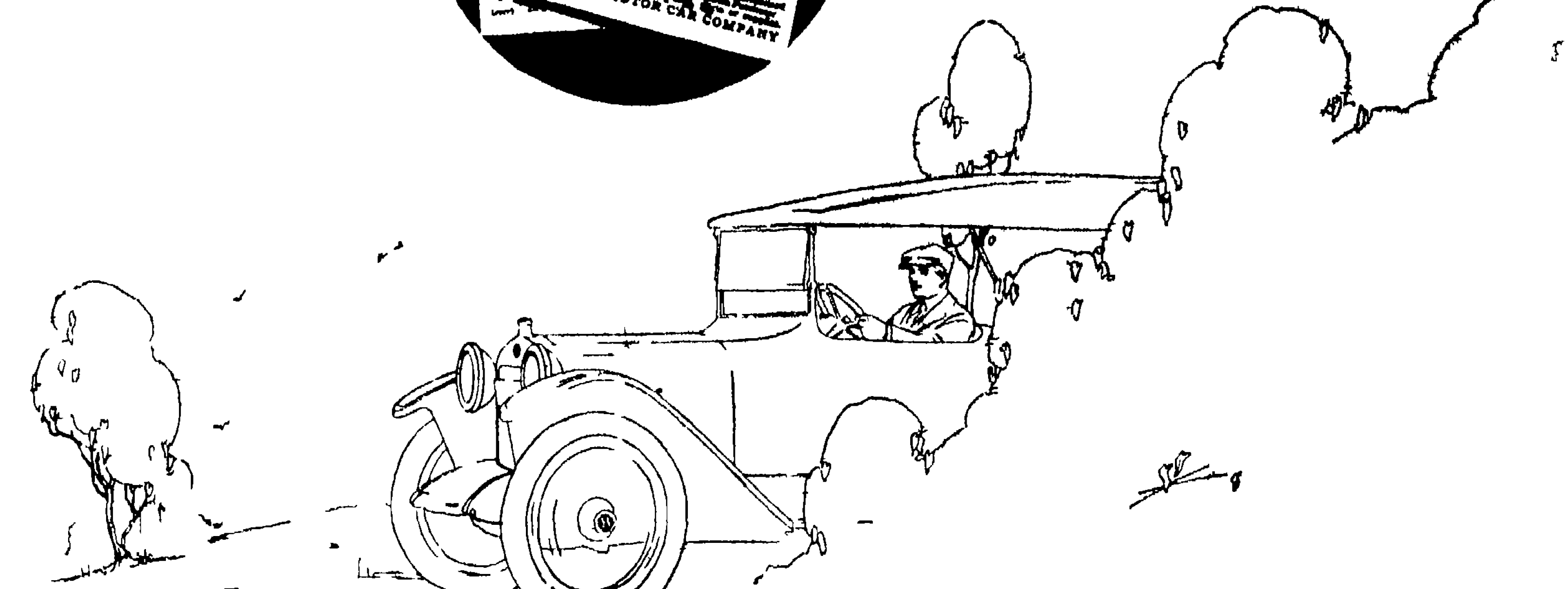
HOISTING UP A GUN TO A COMMANDING POSITION IN THE ITALIAN ALPS

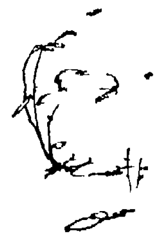
May 27, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

Hup  mobile





BUYERS, and the public in general, count the Hupmobile service system something more than the simple rendition of free service.

They see in it an unwritten — but none the less trustworthy—guaranty of the quality and performance of the car

And they accept it as a further concrete expression of our belief that the four-cylinder Hupmobile is the best car of its class in the world."

Indeed, no car less worthy could support a service system such as we have installed for Hupmobile owners

For your own sake, find out about the Hupmobile service plan before you buy any car.

Hupmobile service is now available at more than 4000 Hupmobile service stations in all parts of the United States and Canada Owners pay for it with coupons which they receive without extra cost when they buy their cars Coupons are sufficient for 50 hours of service labor

In the first quarter of 1916 Hupmobile sales showed an increase of 62 per cent over the corresponding period of last year

Hupp Motor Car Corporation, Detroit, Mich

Five-passenger Touring Car	$1085	Year-'Round Coupe	$1165
Year-'Round Touring Car	1185	Seven-passenger Touring Car	1225
Two-passenger Roadster	1085		Prices F. O. B. Detroit

Courtesy First—Safety for Others in Motoring

The mark of superior H *motor car service*

SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV] NUMBER 22] NEW YORK, MAY 27, 1916 [10 CENTS A COPY $3.00 A YEAR

A gentle shower, under perfect control. Showing installation of the overhead irrigating system on a New Jersey farm

Gathering lettuce on a 40-acre "patch" Four crops are matured and ready for market when best prices prevail

Turning Out Crops on Schedule Time

NATURE does not always do her own work best. At least, that has been the general experience of the farmer Seasons are unhappily anything but uniform in the matter of weather, and a successful crop hinges very much upon the character and distribution of the sun's heat and the cloud's outpouring Of the two, showers even more than sunshine are the prime concern.

This is all by way of prelude to describing just how one tiller of the soil has managed to circumvent these seasonal vagaries and to make it possible for farm products to be ripened on schedule time, and with a nicety of control that can best be likened to the output of a factory

By means of a novel system of irrigation, Mr Charles F Seabrook, of Bridgeton, New Jersey, is able to raise products that are sold in Philadelphia and New York in direct competition with similar foodstuffs shipped from Florida at a time when the South has a decided climatic advantage. Further, he realizes a larger crop per unit of area

The irrigation employed on his farm is of a sort that simulates a gentle rain and is delivered to the plants by a system of overhead pipes These are perforated, and into each hole is screwed a wee brass nozzle that sends the water up into the air in the form of a fine spray This settles upon the ground so that it does not hurt the texture of the soil, and is carried down to the thirsty roots with the least possible loss. A hard rain attacks the surface soil, packs it, and is very apt to leave water standing. This, when evaporated by the hot sun, causes the surface to crust, which prevents subsequent rain from working freely into the ground, and results in increased evaporation.

In a measure the same objection can be cited against irrigating by means of ditches and canals. A great percentage of the water is wasted, space is used that might otherwise be devoted to the raising of crops; far more water is necessary than the overhead system requires; and the seeds of weeds and the like are carried where they will cause trouble. Indeed, the very fertilizer is partly drawn away from the plants for which it is intended. Overhead irrigation is [illegible] and economical, because it is [illegible] of the nicest control. It can be [illegible] when it will do the most [illegible] this may be at times only [illegible]

About six years ago Mr Seabrook equipped three acres of his farm with his rain making apparatus Last fall he had 110 acres so piped, and now this system of irrigation has been extended over 50 more acres of his farm No matter how abundantly a soil may be fertilized, this enrichment will fail of its purpose without an ample supply of water carried down from the surface of the earth It is in this way that the tonic of the fertilizer is dissolved and made ready for the roots to drink it in This done the moisture passes up through the plant and is in turn evaporated through the agency of the foliage It is really a natural pumping system, and the function of the leaves is to complete the circulation. How necessary water is to plants can be gathered from the fact that for every ton of hay let us say, 500 tons of water are required during the life history of the growing grass Therefore, increased fertilization by stimulating plant growth incidentally augments the thirst This very abundant foliage in turn, enables the vegetable better to withstand nature's excess of rain At the same time a hardy plant quickly becomes too strong to be injuriously attacked by disease

Digging potatoes. An early crop of 625 bushels to the acre, which brings a high price because of its priority

Bleaching celery by using paper instead of dirt The ripening of the crop is thus successfully speeded up

How successfully this method of farming has worked out can be gathered from the following facts In that part of Cumberland County the average farmer, employing customary methods raises between 100 and 200 bushels of potatoes to an acre while Mr Seabrook obtains a crop of 625 bushels on the same unit of area What is more than that he gets his potatoes ready for the market some time ahead of his neighbors and just when new potatoes bring high prices Again in that region the run of farmers are pleased if they get 3000 baskets of strawberries per acre while Mr Seabrook isn't content if he gets less than 10 000 baskets of large finely flavored fruit And so it goes with all of his crops which include among other things lettuce romaine celery onions carrots radishes, beets tomatoes etc

There is a period when young plants must be guarded against chill and again a time when maturing plants must be protected from frost For this service Mr Seabrook uses what he calls "shade cloth tents," a gauzelike fabric or special make of cheesecloth This material acts like the wire netting around a miner's lamp and separates the two columns of air As a result the sun's rays can penetrate and heat the atmosphere beneath the tents and yet, after nightfall, that warmer air is held there by reason of the protecting meshes

Farmers throughout the world might well follow Mr Seabrook's scientific farming methods to advantage

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, May 27, 1916

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns especially when such articles are accompanied by photographs.

The Report of the Conference Committee on the Army Bill

SENATOR CHAMBERLAIN, in presenting to the Senate the report of the conferees, announced that the final decision reached was the result of a compromise. He claimed that it was a good compromise and in so far as the Regular Army is concerned his claim is justified.

The bill as now presented gives the organization asked for by the General Staff of the Army. It provides for seven regiments and two mounted battalions of Engineers, for sixty five regiments of Infantry, twenty five regiments of Cavalry, twenty one regiments of Field Artillery, a Coast Artillery Corps of greatly increased size, and the necessary staff corps and departments for proper administration.

The Army as provided permits of organization into seven divisions of all arms, two cavalry divisions, and a slightly increased garrison for Alaska and Porto Rico. There will be assigned to the Philippines, the Hawaiian Islands and the Canal Zone each one division, leaving four divisions and two cavalry divisions in the United States proper. The Coast Artillery Corps will be sufficient in strength to permit the manning of all coast forts in our foreign possessions and the manning of all mine fields and one half the gun and mortar batteries at home.

The organizations, however, are not at war strength. The infantry company is held to 100 enlisted men, while the drill regulations call for 150, the other arms of the mobile army are proportionately skeletonized. But even in this respect there is a considerable improvement, as the present infantry company has, until very recently, been limited to 65. And the bill leaves it in the discretion of the President to bring the units to full strength. Elsewhere in the bill, however, he is limited, except in time of actual or threatened hostilities, to a total force which will not permit full war strength of all organizations at once.

The Regular Army

There is a considerable difference of opinion as to the strength of the army authorized by the report. A reading of the bill accounts for this. The enlisted personnel of the Quartermaster Corps, the Ordnance Department and the Signal Corps are left to the discretion of the President, as is the organization of brigade, division, corps and army headquarters. Again, in Section 2, there is a proviso that the total enlisted force of the *line of the Regular Army, excluding the Philippine Scouts, the Quartermaster Corps, Medical Corps and Signal Corps, and the unassigned recruits*, shall not, except in time of actual or threatened hostilities, etc., exceed a total of 175,000 men. Since none of the branches italicized has ever been considered as part of the line of the Army, and since there are others not mentioned which also are not part of the line, an interpretation will be required to determine to just what troops the limit of 175,000 pertains.

Presuming that only those excepted are in addition to the force prescribed, the army would have between 210,000 and 215,000 enlisted men, depending somewhat upon the strength authorized by the President for the Quartermaster and Signal Corps, this on the assumption that all unassigned recruits authorized were on hand at depots. In addition to the enlisted men, the bill authorizes approximately 10,000 officers, combatant and staff, bringing the full strength to something like 225,000.

The increase is to take place in five yearly increments, the first becoming effective on July 1st, this year. This is a wise provision, as it enables the new material to be absorbed gradually. And the President is authorized, in emergency, to hasten the organization at his discretion.

What we are most interested in is the strength of the fighting army. As nearly as can be calculated (on account of some indeterminate units described) the following are authorized:

Normal Strength—

Engineers	Infantry	Cavalry	Field Art'y	Coast Art'y	Total
5,180	85,760	27,950	17,640	29,447	164,887
President may increase to—					
7,874	120,065	39,820	27,884	29,447	220,590

The above is the enlisted force only, to these totals should be added approximately 7,000 officers for these branches.

It will be seen that the limitation placed on the total strength of the line of 175,000 will prevent the President from making the full increase in time of peace.

In addition to the new organization provided, there are many other praiseworthy features. Among these may be mentioned the enlistment clause, whereby a soldier need serve no more than one year with the colors if he qualifies for the reserve in that time. This, with other provisions favoring the formation of a reserve, should soon correct the absurd position in which we find ourselves to day in this important factor of national defense. Also, it should serve to stimulate enlistments. The shortening of the required term of service to three years, greater consideration as to travel allowances on discharge, the opportunity for advancement offered by the extra non-commissioned positions for duty with the militia and at colleges should all serve to make the army a more attractive career for the class of young men we should like to have.

The aviation corps has been increased to more than five times its present size. There is a workable plan for a Reserve Officers Training Corps and the formation of an Officers Reserve Corps and a liberal allowance of extra officers for duty with the National Guard and at colleges. In all, practically everything that could be asked for the Regular Army has been given.

The Federalized Militia

It is to be regretted that the same unqualified praise cannot be extended to the National Guard portions of the bill. Justice compels us to acknowledge that the conferees have done their best with an impossible situation. Every safeguard that could be thrown around the national interests appears to have been thought of. The very objectionable feature of detailing National Guardsmen on the General Staff of the Army has been dropped, and the requirements for a militia organization to become entitled to pay have been stiffened remarkably. The supervision of the Secretary of War is very broad and, if exercised as it should be, will easily prevent the expenditure of funds on those not returning service.

But, when all is said, the Militia remains the Militia and a state force. In spite of all the laws that may be written, the Constitution places limitations on its control and use by the President, which will govern just as soon as any individual or organization of that state force cares to appeal. If the Constitution did permit all that the proposed bill provides, and we could be sure that the bill would not be amended, there can be no doubt that the resulting force would be a better one than we have ever had organized in the states. The maximum instruction prescribed (48 drills per year and 15 days in camp) would cause a soldier of Europe who had gone through two years of intensive training seven or eight hours a day to smile; nevertheless, it will produce a better militia than any we have had to date.

The danger, of course, is that the bill will be amended. When the full 800 National Guardsmen have been enrolled in each Congressional District we may see the supervision of the War Department greatly reduced, and the restoration of all the porcine features now eliminated.

Better and wiser by far would it have been to have retained the Volunteer clause, and thus have enabled the President to organize a truly federal force, one over which his constitutional control would be unquestioned. This was strongly urged by all the Regular Army and was favored by the rank and file of the majority of the Militia. There seems reason for the statement of one Senator that "politics not prepared ness governed the legislation in this respect."

As an exchange for the Volunteer Army, we have generous provision for camps of intensive training. All expenses of those volunteering to attend these camps are to be paid. This is a stop gap. These camps were originated by our leading military men *because there was no dependable citizen army in reserve*. They were the best that could be conceived without legislation authorizing such a reserve. But no matter what the success of these camps, *they cannot take the place of an organized force in being*. We can only hope that the influence of those attending will eventually bring about a reconsideration of the discarded provision for a federal force of trained citizens behind our Regular Army.

We now await the appropriation for munitions of war. Will Congress give the necessary funds for the additional arms, ammunition, equipment and other stores without which an army cannot be effective? Our lack in this respect has been broadly published. The people know the true conditions, and are watching hopefully for generous remedial action. To vote for more men and make no provision for arms and equipment would be futile legislation; for the outstanding lesson of the European war is the controlling importance of guns, shells, machine guns and rifles.

Build the Ships To-day

WE commend to the "small navy" members of Congress, whoever they may be, the story of the decline in relative strength of the United States Navy, which is illustrated in the comparison to be found on another page of this issue.

It was about a decade ago that the dreadnought era opened, and up to that time the United States was recognized as the second great naval power in the world. At that time our fleet was markedly superior to that of Germany, the third ranking power, for the twenty four ships of our pre-dreadnought fleet were not only on the average larger, faster and better protected than those of Germany, but their gun power was overwhelmingly greater, the total energy of all guns of the battleships being about 3,800,000 foot-tons, as against a total gun energy for the twenty German battleships of 1,640,000 foot tons.

So effectively have the "little navy" men in Congress carried on their senseless war against naval preparedness that to-day we have lost our second position to Germany and are in danger of being outstripped by France. The conditions in comparison with Germany have been completely reversed, so that, judged on a basis of first line battleships (dreadnoughts and battle-cruisers), we have less than half as many ships completed, namely, twelve as against twenty six, and the total gun energy of our first fighting line is but 7,417,736 foot tons against the total of 13,226,000 tons, representing the total gun energy of the German dreadnought fleet.

That is what the spirit which has been back of the so-called pacifist movement has done for the United States Navy, and we invite the attention of the exponents of that movement, both inside of Congress and out, to the fact that our present diplomatic relations with that power which has moved into the second position which we have so fatuously given up, is such that at any hour a little indiscretion or deliberate bullheadedness on the part of a submarine commander may find us at war with that naval power which to-day is so vastly stronger than we are ourselves.

Surely it is a truth which goes without saying, that if we are to have a navy it should measure up to the full limit of its responsibilities. The navy which we have is absolutely first-class, both as to ships, officers and men, but it is altogether too small for the enormous task of safeguarding the lives, homes and property of a country which numbers 100,000,000 people and whose wealth is double that of any other nation.

It is one of the first, if not the first, of the duties of Congress to bring up our Navy with the greatest possible speed to the position which it once held, and has now lost. Secretary Daniels's five-year program will never accomplish this. Battleships, battle-cruisers, scouts and destroyers should be built up to the full limit, year by year, of our shipbuilding facilities. We are gratified to note that President Wilson is reported to be in favor of building four battle-cruisers and two dreadnoughts this year.

The House Committee on Naval Affairs has voted for five 35-knot battle-cruisers, four 35-knot scout cruisers, ten destroyers, twenty submarines, one hospital ship, one fuel ship, and one ammunition ship. This program does not meet the emergency. It should be increased by two battleships, twenty destroyers, and four scout cruisers. We should have four destroyers to each battleship in our Navy, and the proposed battle-cruisers call on this basis for twenty destroyers.

Americans to Aid Reconstruction in France

THE American Manufacturers Export Association of New York, a national body including several hundred of the largest manufacturing exporters in the United States, is now organising an American industrial commission to visit France during June and July next, with the full approval and co-operation of the French government, for the purpose of making an exhaustive and technical investigation of present conditions in that republic, looking to the reconstruction and reorganisation of her communities and industries.

Already plans are being evolved in France, not only for rebuilding those of her factories which have been destroyed by the war, but for equipping with the most modern machinery her existing industries, and putting these in a condition to increase their output and to enable the Republic to meet on equal terms the tremendous commercial competition which is expected to follow the close of the war.

Automobile Notes

Low Grade Fuels Coming — At a meeting of the Society of Automobile Engineers a speaker recently said "We are going to be face to face with the necessity of burning low grade fuels, and if we simply postpone it we are just putting off the trouble The garage man, if nobody else, is going to make us face the problem, because he is putting kerosene into the gasoline."

Difficulties in Shipments —Owing to the difficulties in procuring suitable freight cars for shipping automobiles, many companies have been using flat cars covering the shipment with tarpaulins, but it is found that many of the detachable fittings such as speedometers, spare wheels, rims, tires and tools disappear en route. Now the wise ones are stripping the cars of everything readily removable, and shipping these parts separately

Cost of Running the Car — "In spite of the high price of gasoline it really does not cost us any more per mile to run the average 1916 car than it did the cars of 1905 or 1906," is the statement recently made at a meeting of the Society of Automobile Engineers and the speaker further said 'The increased efficiency of engines and decreased weight of car have certainly enabled us to go more miles on a gallon of gasoline, in fact, I think almost double what was possible ten years ago, or even five years ago in this country '

Armored Fighting Cars — A year ago great things were expected of the armored automobile and it certainly made a good record for a while but as soon as both armies dug themselves in its usefulness was greatly discounted Where armies are engaged in active and rapid movements not mere sorties from trenches the armored car is of great value but at present it is being little used in France On the other hand the ammunition and supply cars that have to go up to the front are now frequently armored with advantage although their means of offense or rather defense is limited to the rifles of their guards

Developing Aircraft Engines —Some of the most successful aircraft motors now used abroad were developed, tested and worked out by mounting them in a racing type automobile chassis which enabled long and severe trials to be made under constant observation This method is now being adopted by one of the prominent American automobile companies which is building a very successful twelve-cylinder automobile engine and now, with a view to preparedness is at work on developing designs for aircraft service It is proposed to thoroughly compare engines with four six eight and twelve cylinders of equal piston displacement, and undoubtedly the data obtained will be of great value in developing new designs Such efforts are not only evidence of commercial progressiveness, but are distinctly patriotic, for as the war goes on we more fully appreciate the backward condition of our aeroplane service

Other Types of Engines Should Be Developed — The following significant statement was recently made in a discussion before the Society of Automobile Engineers "There is another fact that we as engineers should not overlook Other types of engines than those built on the Otto cycle may and should be developed for use in automobiles An engine built for example, on some constant pressure cycle will not only give a higher thermal efficiency, but possesses certain inherent qualities notably a more nearly constant torque that make it more like the steam engine Engines built on the Otto cycle have a theoretical maximum thermal efficiency of about 35 per cent In practice the best that can be obtained is 18 or possibly 20 per cent This is only under maximum load conditions But on the average automobile engines run at very low duty and with low compression pressures Under those conditions the thermal efficiency may be as low as two or three per cent" Who will be enterprising enough to start the movement?

High Gears on Hills — Are not automobile manufacturers and dealers injuring themselves by putting so much stress on the hill climbing qualities of their cars on high gear? The amateur driver is told that his car can climb anything on high, and naturally he attempts to do it with the result that he seriously racks his car by hanging onto the high gear too long and then takes a week's wear out of the gears in attempting a frantic, last second change It is exceedingly poor policy, and bad practice as well to hang onto the high gear on a hill until the engine begins to pound in the hope of pulling up the last few yards without a change, as this pounding indicates that the engine is being strained in a way that will surely shorten the period of its usefulness. The gear should be invariably lowered while the engine is still pulling freely, and further lowered at the slightest sign of distress. The loss in time resulting from this system of driving can be counted in seconds, while the increased usefulness of the car is measured by months.

Science

Amundsen's North Polar Drift.—Captain Amundsen's project of exploring the north polar regions by drifting with the ice, after the example set some years ago by Nansen in the "Fram," was temporarily abandoned at the outbreak of the European war, but has now been revived The explorer hopes to set sail next summer

Gregorian Calendar in Bulgaria —According to the London *Times*, the Bulgarian national assembly has voted to adopt the Gregorian calendar in place of the Julian or eastern calendar, to which it has hitherto clung chiefly in deference to the Russian hierarchy This desirable reform is, therefore, partly due to political motives

Meteorology for Military Aeronauts.—Under the auspices of the British Meteorological Office a professorship of meteorology has been established for the purpose of giving instruction and conducting researches in that science in the interests of the Royal Flying Corps of the British Army The incumbent of this post is Mr G I Taylor, late Shuster reader in meteorology at the University of Cambridge, who receives the temporary rank of major in virtue of his new duties

Foreign Marine Charts.—The U S Hydrographic Office announces that it has made substantial progress in the important work of reproducing by the photo-lithographic process, on zinc plates, the British Admiralty and other foreign nautical charts that it has heretofore been obliged to purchase from abroad, and it is expected that our navy and merchant marine will soon be independent of foreign chart makers During the past year the office purchased 19,222 charts from the British Admiralty

Fertility of Pollen Affected by Transfusion of Sap — The following interesting experiment is reported by R Holmes in the *Gardeners Chronicle* A large plantation of a certain variety of fruit trees failed to fruit It was found that they could be made to fruit freely when artificially pollinated with pollen of another variety In order to effect the same result a graft of the pollinating variety was inserted on the top of each tree In due time following this procedure the trees fruited but the grafts had not borne any flowers and consequently had not produced any pollen! Apparently the character of producing fertile pollen had been introduced merely by the transfusion of sap from a fertile to a sterile variety Further experiments are being conducted in this connection

Education Benefits the Farmer — A circular recently issued by the Missouri Agricultural Experiment Station records the results of a comparison made in 1912 between two groups of farmers, viz. 554 who had received only a rural school education and 102 who had received a greater amount of education extending on an average, through two years of high school From this comparison it appears that the better educated farmer is making an income 71 4 per cent greater than the farmer with less education, and even after the labor income of the latter is adjusted to allow for his smaller size of business, the difference still amounts to about 40 per cent Not to mention the intellectual benefits of an education—far surpassing anything that can be measured in terms of dollars and cents'

Discovery of the Remains of Another Eoanthropus — Sir Ray Lankester in his Diversions of a Naturalist published last fall makes what is perhaps a premature announcement that Mr Charles Dawson has made a recent discovery of a second skull of the same character as the first He goes on to state that this discovery was made *at the same spot* (Piltdown) and remarks that this justifies a certain amount of hesitation in concluding that the lower jaw and the first found skull belong to one individual (*Eoanthropus*) On inquiry we find that this second series of bones although found in gravel of the same age as that of Piltdown is from a bed situated one or two miles away from Piltdown There is evidence that the lower jaw of this second individual was of the same type as that found associated with the Piltdown skull

Do Bees Injure Fruit?— An agricultural society of Florence Italy has recently carried out a thorough investigation of the alleged injury of fruit by bees and has completely exonerated the latter Bees are unable to perforate the skin of fruit and it is only incidentally that they suck the juices of fruits injured by other natural causes The damage sometimes attributed to these insects is due to poultry, wild birds wind and hail, and even more frequently to hornets wasps vine moths, and other insects Instead of being harmful to orchards and vineyards, bees perform the useful service of effecting the cross pollination of flowers and hence the setting of fruit, as well as the desiccation of damaged fruits (especially grapes) by sucking the juice and pulp and thus preventing fermentation and rot extending to sound individuals. The orchards and vineyards frequented by bees give the most constant crops

Invention Notes

Invented the Rotary Cement Kiln — The death was announced at East Orange early in March of Dr George Duryee the inventor of the rotary cement kiln He practiced medicine for forty years in Albany N Y and about twenty years ago he became interested in some cement enterprises and realizing that the cement industry was hampered by the lack of proper manufacturing facilities he gave up his practice and made the rotary kiln which was soon resorted to generally The improvement was responsible for a great change in the business He was also responsible for several improvements of a minor nature

Ready Made Tees for the Golfer — The ready made tee is one of the latest refinements of golf The device has been recently patented A board designed to be sunk into the ground of the green has a depression in it made to accommodate a revolving device with a variety of seats disposed upon its surface any of these being presented according to the desire of the player Three of these seats it is anticipated will be sufficient to gratify the whim of any golfer although more may be mounted upon the spindle if it should prove desirable This will save the time and temper of players in making the tee from the sand and water which form part of the equipment of the teeing ground

Water Leak Detector —To the proprietor of a large industrial establishment where the water supply is drawn through a meter the matter of leakage is a very important one for a comparatively small number of leaks working constantly as they do, may be responsible for a considerable increase in the bill at the end of the year A means of detecting and locating these leaks has been devised The appearance of the instrument used is much like the receiver of a standard telephone set The point of the instrument is placed in contact with an iron rod driven in the ground or to the key which has been placed in position on a street surface valve, and if there is any leak in the vicinity it is betrayed by sounds in the instrument

New Features in a Locomotive —Samuel M Vauclain, of Philadelphia, whose name has long been associated with the designing and building of locomotives was recently granted a patent covering certain improvements in compound locomotives of the centipede type in which there are three pairs of cylinders In this instance there are three independent frames connected by articulated joints two cylinders are mounted on each frame one at each side of the locomotive There are preferably eight driving wheels for each set and the cylinders are coupled so that one high pressure cylinder will exhaust into two low pressure cylinders at one end of the locomotive and the other high pressure cylinders will exhaust into the low pressure cylinders at the opposite end of the locomotive By this arrangement it is possible to make all the cylinders of the same size, thus materially economizing in the cost of the manufacture of a locomotive

Turnstile to Prevent Crowding the Mine Cages — Ten men is the limit of the safe capacity of the mine cages at the mines of Jermyn & Co at Rendham, but when the workmen are eager to get to or away from their work they will not pay attention to this restriction and the result is that accidents are likely to result This carelessness or negligence on the part of the workmen has been overcome by an ingenious invention of the superintendent John Corcoran It consists of a turnstile with four spaces which will revolve exactly two and a half when it reaches the limit of the screw on which it is mounted Then the gate to that shaft is closed and that to the adjoining shaft opened and ten men admitted by the turnstile revolving in the opposite direction to that shaft The only way in which more than ten men can get by this turnstile at one time is by climbing over it which is rendered somewhat difficult by the construction of the turnstile

Electricity as a Tree Pest Cure —Patent papers were recently granted to Isadore Kitsee a Philadelphia inventor covering a process for the destruction of insect and germ life harmful to plants and trees the electrical method taking the place to a great extent of the usual sprays and other applications The process consists of making an application of a solution such as saline water where the ground is to be treated and then causing a current of electricity to be passed through the soil whereupon the gas generated will rid the soil of germs larvae and insects without the least injury to the vegetation Where a larger area is to be treated it has been found desirable to dig shallow trenches at opposite sides of the area to be treated and the electric terminals are placed in these An application of a somewhat more powerful current will rid the entire area of pests When the plant itself is to be treated the solution carrying the element is made the electrolyte in an apparatus and the plant sprayed with a solution after decomposition has taken place through the action of the electric current

Shipbuilding Resuming Its Old-time Importance in American Commerce and Industry

Activity of Our Shipyards Since the Outbreak of the European War

By J. Gordon Dorrance

NOT since the days of the Yankee clipper, when fleet and full rigged ships, American built, American owned, American manned, swept over all the Seven Seas, searching for and finding their full share of the world's trade, and the term "merchant prince" was not unknown this side of the Atlantic has there been given to our shipbuilding and our shipping, but most of all the former, so real an impetus as they have both received within a few months time Anything which has been long paralyzed cannot immediately be charged with life, however and the European war had been carried on for a good year before the shipping interests of them, as did some others who were not then shipowners or shipbuilders, but decided to become so. Their judgment has since been amply justified.

On July 1st, 1915, there were building or under contract in American shipyards 46 vessels, between that time and December 1st 52 additional ships were ordered, bringing the total of those under construction up to 761,511 gross tons on the latter date. Of them, 47 were built to hold bulk oil, 34 general freight, 11 were colliers and 6 were for passengers and freight. These figures are a good index as to the character of the present trade. The 29 principal shipyards at Baltimore,

Ready for launching The hull is finished, and the S S "Ulysses" is shown on the ways, waiting to take the plunge

America began to feel in earnest an improvement in the different branches of their trade Almost until the late summer of last year they were doing, it is true a good business in repairing many foreign and a few domestic, ships, but yards were operating at less than normal, with business by no means unusually good Just then, however, things began with a rush, and it is probably safe to say that there is not now one plant in the United States, equipped for modern work, which does not have its docks, as well as books, quite comfortably full of a new sort of business.

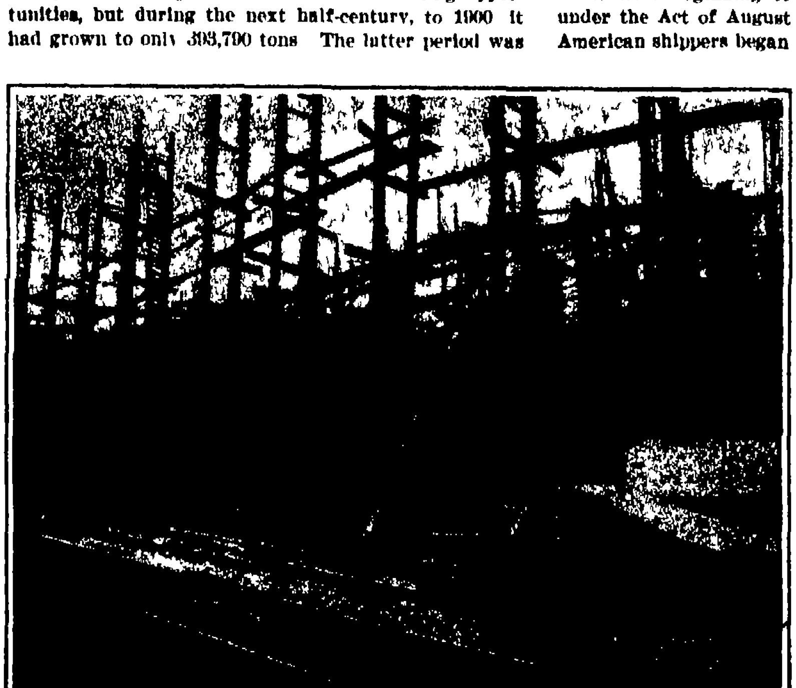
Credited in 1909 with 1,358 ship and boat building plants, 40,506 wage earners, and a combined product worth annually $73,361,315, it then held but thirty fourth place among the great American manufacturing industries in labor employed, standing just sixtieth in the value of its products. Not a very good rating, you will say, for a land like ours, with its thousands of miles of coast, its dozens of harbors offering easy approach and adequate berths, and its quite unexcelled facilities and water ways of every sort. Yet this is by far the better side of the account, for the wage earners given employment then had decreased 13 4 per cent from 1899, 20 2 per cent from 1904, with respective declines in products of 1 6 and 11 4 per cent for the same periods

In 1800 this country, then very new, was constructing at a few yards scattered along the Atlantic seaboard vessels amounting to 106,261 gross tons Fifty years later this had risen to 279,255, a healthy increase, surely, considering the times and the existing opportunities, but during the next half-century, to 1900 it had grown to only 393,790 tons The latter period was also one of transition from vessels all of wood to those built principally of steel and iron It should have been a constructive stage But the small growth shown was in reality little more than a decline, and this decline was not long in manifesting itself in other ways Exports of domestic merchandise for fourteen years, from 1901 to 1914, averaged in value $1 774,000 000 per annum Those worth $1 570 000 000 were sent in ships, *the rest in cars and American steamships carried 7 3* per cent of the American exports, foreign vessels of course the rest In 1901 the rating was only 4 8 per cent, in 1906, 9 2 per cent, and in 1914 it was but 7 8 per cent Things nautical had reached their low ebb here, and it was then that chance, abetted somewhat by the old Yankee readiness to seize an opportunity, interfered to make a change

Some of Europe's great home industries were slowing down, their mines among the rest, and with a dwindling output came, in most cases, a heavily increased demand France and England were ready to take all of the American coal that they could get Price was not the great consideration, either It was ships. Italy and Spain, to a lesser extent Russia were similarly disposed toward American fuel, metal and foodstuffs, and while these countries were attempting to buy here, some others, like Japan, were beginning to direct attention there, and wisely starting to build ships. Perhaps we might have missed this opportunity, as we seem to have overlooked some others along Transatlantic and Pacific commerce lines in recent years, but vessels of foreign make were beginning to have their registry changed under the Act of August 18th, 1914, so that some few American shippers began to see their chances, and took Newport News New York, Philadelphia, Wilmington, San Francisco and other centers were, as they are now, full of both men and boats, and working over time. Earlier in the summer these people complained of having to employ 200 men where there was room for 500, and how many of them have twice the latter figure working on domestic orders which must be filled to clear the ways for more Yards have been doubled in size and capacity, and new ones put in use

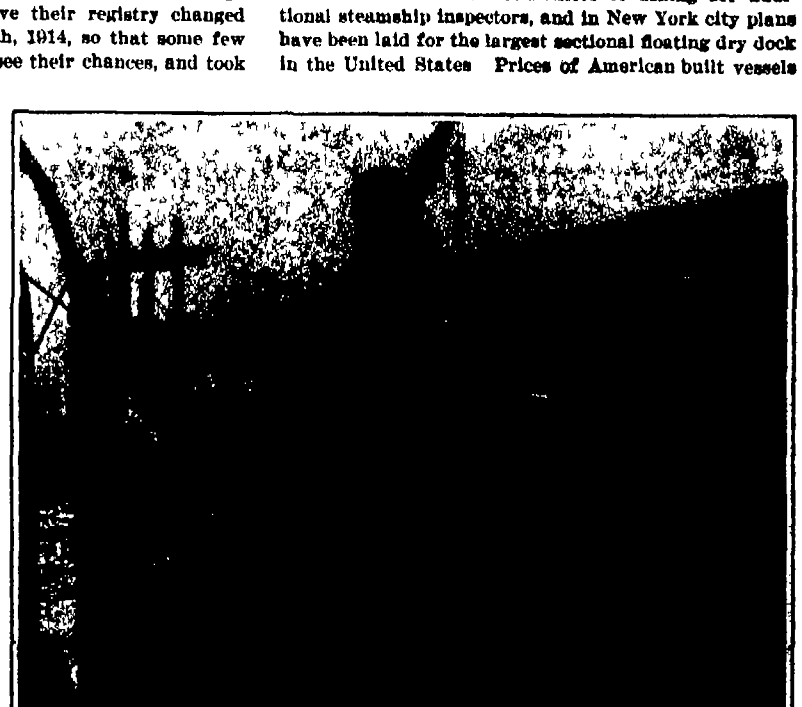
Deducting vessels lost, abandoned or sold to aliens up to December 1st, there is a net increase of 187 vessels, 53 829 gross tons, in our Merchant Marine since the 1st of last July, a better showing, certainly, than we have seen for some time past. There is now under construction at just four of the leading yards a gross tonnage amounting to 418 000, as contrasted with a total of 316 000 tons for ships built during the year of 1914, and 346,000 for those of 1913. Vessels arriving last year at the port of New York were 10,279 in number, and 9,203 for the year before German and Austrian vessels declined 397 in that time, some others also, so that the comparison drawn is even more encouraging

This sudden momentum is not confined to any single part of the country Some of the smaller cities—Bath, Maine, Manitowoc, Wisconsin, Ferrysburg, Michigan; and others—are looking forward, so reports have it, to shipping and shipbuilding booms. The House Merchant Marine and Fisheries Committee is asking for additional steamship inspectors, and in New York city plans have been laid for the largest sectional floating dry dock in the United States Prices of American built vessels



The first step

Inside the dock the steel ribs of the framework are appearing, and the new boat, a freighter, is just beginning to take shape.



A busy corner

Shifts of men are doing double duty, and each ship in building is rushed to completion to make way for the next.

have advanced 50 per cent in six months, labor has enjoyed a corresponding increase. Some of the greatest shipbuilding nations in the world, formerly, are now no longer able to hold their own along commercial building lines. Other countries are stepping into their places—Norway, Denmark, Sweden, these latter both building at home and buying here. But yet the world production of ships is very far below the normal, and manufacturers here are trying hard to make this up.

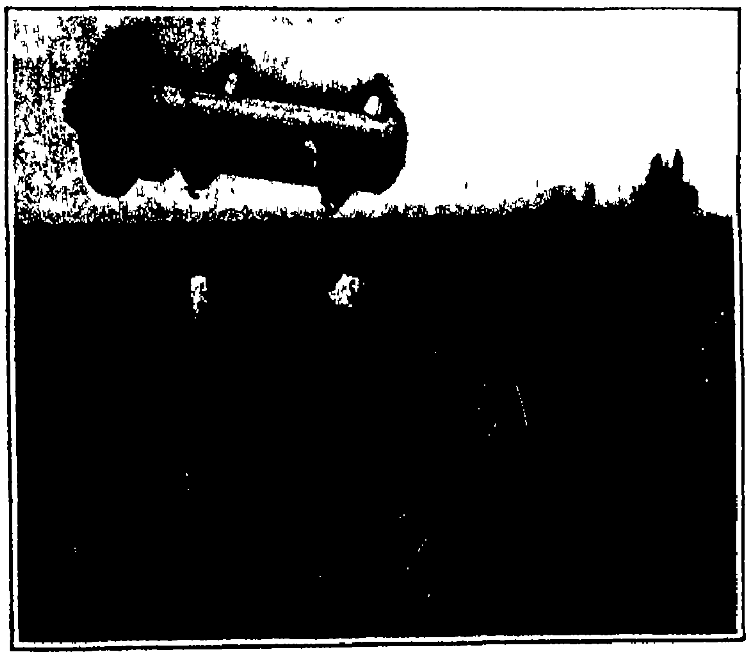
A man prominent in shipbuilding said not long since that his business, and that of practically all others, was no longer a question of costs and prices, but of deliveries. "If we can get the steel, our plants will operate twenty hours a day for more than a year on orders already placed, and it is all *building*. Practically no repair work is being handled now, for under present industrial and economic conditions there is relatively no profit in it. Ships being built for the Transatlantic trade are ranging in price from $500,000 to $1,250,000, and most of them are paying for themselves within a year." Owners cannot afford the delays repairs entail, nor builders afford to make them with their prices for gross tons rising from $60 to $95 in much less than one year. So that the present loss from neglected and postponed repairs and over worked ships is adding to their usual depreciation, only contributing to the enormous demand for other and newer ones.

Of course the export trade is showing enormous increase also. It is a one sided development however, for shippers claim they cannot afford to develop a trade with South America, no matter how profitable it might be ordinarily, while present freight rates across the ocean and the European markets hold. Washington once said that instead of relaxing, we ought to improve the present moment as the most favorable to our wishes.' American shippers and ship makers *are* improving this present moment, and just now one has a trade which is only gaged by the ships at hand to carry it, the other rapidly growing business the extent of which seems only measured by the capacity of all the yards in use. We must look to a well sustained continuance of these conditions after the "boom" has passed.

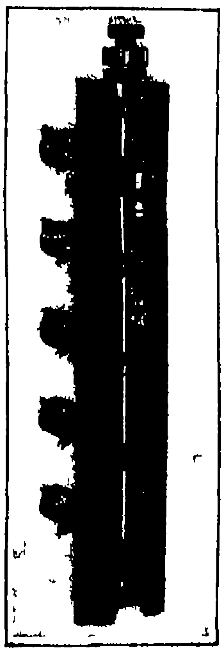
In the American shipyard all is now activity, and new docks are going up where before there was often not work for the old

The Current Supplement

IN the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No. 2108 for May 27 will be found an interesting article on *The Turquoise*, which gives curious information, relating to its supposed medical qualities and the superstitions of many lands. There are several illustrations. *Diving and Diving Apparatus* gives something of the history of these devices by means of which men can work in the depths of the sea and facts connected with their use together with an illustration. *Military Telescopes and Binoculars* describes a variety of optical instruments that are used for making observations during military maneuvers and a number of illustrations and diagrams accompany the text. The lectures by Sir J. J. Thomson on *Radiations from Atoms and Electrons* are continued. A timely article is that on *War Projectiles* which gives details in regard to the calibers of the various shells now being used by different countries. This is an extremely valuable article for the technical reader. *Surface Combustion* is a subject that has not as yet been given the attention it deserves. The survey of the subject here given together with facts and diagrams, is of more than ordinary interest. *Steam Power for Aeroplanes* sounds like a step backwards but this article gives the results of a serious technical study of the subject by a steam specialist, and it demonstrates that in following the gasoline fashion sight has been lost of the modern advances that have been made in developing steam power and the wide possibilities of application these have made. The facts here given will be a revelation to many. *The Buoyancy of Zeppelins* discusses the function of the ballonet and how the buoyancy of these craft of the air is adjusted to varying aerial conditions. Other articles of value in this issue include *Babylonian Cosmology, Metals to Replace the Carbon Arc* and *Platinum Varnish Troubles* besides various technical notes.



Cotton-picking machine, showing the arms which carry the rotary picker points for plucking the cotton bolls



Rear view of one of the slats

Rear view of the cotton-picking machine, showing how the seed is plucked by the picker points and delivered to the hopper

A Machine That Picks Cotton Without Injuring the Plant

WITH the cost of labor constantly rising, particularly during the past twelve months, many American industries are confronted with a serious problem. And the problem is the more serious in those industries where human labor still reigns supreme and where machinery has made but slight, if any, inroads. A typical instance is the cotton growing industry, in which the picking of the bolls is still done by hand.

During the year 1914 the cotton produced in the United States aggregated 16,645,272 bales, representing the crop yielded by 36,060,000 acres of land. This quantity represented about two thirds of all the cotton marketed in the world. The cost of picking has been mounting steadily in the cotton growing states and some time ago it attained an average of 75 cents for 100 pounds of seed cotton, with prices ranging from 60 cents to $1 and higher, according to the season and section in which the cotton was being gathered. It is safe to assume that the prices have again climbed to higher levels, following the trend of increasing wages in all other industries.

From the foregoing it becomes apparent that the cotton grower's problem is serious indeed, not only because of the high cost but also because of the loss incurred from rain and storms during the season from the want of help at the right time. It has long been realized that suitable machinery should contribute much toward solving the crop-gathering problem of the cotton grower, and many cotton picking machines have been invented. In the majority of instances however these machines have proved unable to displace manual labor for a variety of reasons. A fairly successful type of machine has been developed, in which two finger like members serve to pluck the cotton bolls by becoming wrapped up in them, but trouble is often experienced by the fingers becoming twisted together or out of shape.

The latest attempt to replace the human element in cotton picking is in the form of a horse-drawn machine of simple yet promising design. It is mounted upon two large wheels with the mechanism for gathering the cotton placed between them. In operation the machine is drawn by two horses directly over a row of cotton plants, so that the picking members can pluck the seed cotton and deposit it in a large wooden hopper carried at the rear of the vehicle.

The cotton picking mechanism of the machine resolves itself into 100 fixed arms each carrying a number of revolving picker points. The arms are fastened upon substantial metal slats, while a rotary motion is imparted to the picker points by a suitable arrangement of gears. The slats move backward at the forward speed of the machine the motion being supplied by power from the wheels transmitted by a chain drive. The picker points and their slats are arranged in two groups, as may be seen in the accompanying illustrations, with a space in the center between which comes the cotton plant to be plucked. As the machine moves forward over a row of plants, the arms carrying the picker points gather the fluffy bolls from practically every part of each plant. The arms remain stationary with the plant while the entire machine moves forward, so that there is no danger of injuring the plant which may still have a further crop to yield in the immediate future. The action of the mechanism is to close in on a cotton plant, pluck off all the matured seed cotton, and then release the plant at the rear of the machine. The picker arms then pass around to either side of the machine, still retaining the cotton. Here the direction of rotation of the picker points is automatically reversed with the result that the seed cotton is released and falls to a conveyor below. The latter carries the cotton up to the hopper or bin at the rear of the machine, completing the cycle of operation. The freed picker points then are carried around to the front

(Concluded on page 564)

Strategic Moves of the War, May 19th, 1916

By Our Military Expert

THE attention of the general public has been invited to the *failure of the German offensive at Verdun* more than to any other phase of the great European War at the present time. Either analytically or instinctively, purely mechanical failure has not been expected of the German arms, their combinations, execution and comprehension of military expediency have been hitherto so scientifically accurate and impeccable that some material measure of victory if only moral, has been generally anticipated. It is with no note of *regret that the Kaiser has missed his target* with no eulogy of allied accomplishment that these lines are written. the cold fact remains that the great effort upon which Germany had relied, upon which she had calculated the gain to be made by an anticipated sacrifice of men for the gaining of a to her cause worth while object, has not brought about the results she hoped for counted upon.

There is a reason for all this. And in the last analysis *it is to be found in the steppes of Russia*, in the incalculable resources of man power potential within the limits of the great white empire. In justifiable apprehension of the power of the Czar's strength should it ever be developed to its full extent Germany knew that her favorable decision should it be reached must come before Russia and her allies could adequately gird their unprepared loins for the test.

It has been a game of give and take, with Germany superior *in organization and ready at hand* force against an adversary of double her strength if it could be aroused from a deadly lethargy before too late. Germany has gained territory upon the west and paid for it in blood territory upon the east at the same though relatively lesser price, *territory to the southeast at even less vital cost*. The numerically strong yet weakly armed hosts of Russia have been locally vanquished made to concede thousands of square miles of homeland territory before tactics, strategy and system. France has witnessed the almost complete occupation of Belgium by her enemy and the wresting from herself of valuable lands including the most productive iron regions of her domains. Serbia is now nothing but a dependency of the Hohenzollerns. *If peace should come to-day* Germany would have won her desired place in the sun and hold all the trumps in the game of barter and bargain which is known as the diplomacy of a war's conclusion.

But peace is not at hand, so the answer cannot now be said to favor Germany for the struggle must be continued further *in the war of attrition* which the Entente is evidently waging.

France has held the greater extent of her territory free of her invader, her battle lines have stopped every assault at every point since the inauguration of the deadlocked trench warfare, and the courage and determination of France to fight to the bitter end whatever it may be has been strengthened and amplified by the moral victory accrued to her at that *militarily unimportant point Verdun*.

The theme of this article is the salvation of Russia as the salvation of the Entente cause seems to lie with the same nation. Without France Russia would probably fall without Russia as a constant menace France even with the tardy aid of England would long since have been brought to taw, policed as Serbia and Belgium have been policed with control of continental affairs in the hands of Germany despite England's dominance of *the sea*. It boils down to arithmetic, no country or minor confederation of countries can dominate the world of the great Powers.

The history of the Verdun campaign is full of things significant, but with none more so than the fact that with all her daring and efforts Germany has never been unwise enough to strip her front which confronts the English, who, in the hour of France's need took over mile after mile of trench sector previously occupied by Joffre's men, for a great army which has been raised under Kitchener, under the handicap of somnolence and political interference, has been held in leash for just some such opportunity.

The domination of Serbia has permitted Germany to withdraw numerous divisions from that conquered land. The industrial poverty of Russia with her three distinct defeats and the favor of the season have permitted the Kaiser to call to the western lines army corps with safety. And his efforts have been met, *checked, stripped of gain*.

Germany has by no means given up. There is an arithmetical limit to the number of men who can be placed upon a given extent of line, and Germany (the Central Empires) still has ample to man them. But the weight of reserves for a gigantic enterprise are lacking, just as France, if she were alone, would lack them.

The safety of Russia therefore lies with France, or, *rather*, with the situation upon the battle line in France to-day. While it is entirely possible that Germany may launch a great offensive upon the Russian front within a reasonably short time, it cannot again embrace the entire extent of the position, for with the Entente forces on the west ready to seize any presented opportunity for attack, as exemplified by the French assumption of the offensive with the attempted withdrawal of the German forces before Verdun a few weeks ago Germany cannot dare strip her western line of men for the purpose.

Relation of the eastern and western battle-fronts

Russia is vastly better off in numbers and general preparedness than she was a year ago, but she is by no means in perfect condition for war. Her political organization is too much handicapped by looseness and pork grabbing *to match the centralization of German* strength which has become so apparent with each passing month of war. It is entirely probable that if Germany should throw even a fair measure of her remaining strength upon the lines of the Czar, they would be compelled to give way. Riga be taken, even the Mohilev Railway, of superlative importance to Russia's communications behind her battle line. But Germany cannot now dare to turn her back upon her foes of *the west for they are in too greatly preponderant* strength.

Germany can count upon little from Turkey. The armies of the Grand Duke threaten the safety of the entire land. Bulgaria will not unguard her own doors —for there are 600,000 allied troops almost at her borders at Saloniki, and her territorial integrity is at stake. England has over 1,000,000 men on the western line—with two millions in Albion or on the way *to continental positions*. France has approximately three million men, all waiting for a favorable opportunity a weakening of the lines before them, to strike for a decision.

Weighing the factors pro and con, it appears as though Russia will not again be called upon to bear the full brunt of the Kaiser's offensive. Locally, yes; but no mighty combinations of army corps being shuttled across the empire in forty-eight hours from front to front. The distance is now too prohibitive, when a determined assault may smash through things in a few hours that have taken months and years to build.

In the earlier days of the war one heard often of the slow grinding of the Russian "steam roller." The magnitude of her vast man power appealed to a public not yet used to armies counting up into the millions, and it could not be grasped that with such a horde available sheer weight of numbers would not count immediately. Vaguely, the public supposed that Germany was perfectly prepared for war, France a little less so, England still in her might, with Russia somewhere nearby in the scale of technical preparedness, and it was not until the second monumental defeat of the whole Russian army was registered to the credit of Germany that realization came of the horrible political hodge-podge which existed within the Czar's broad country. Undoubted stories of graft in high places of needed munitions held back for commercial purposes, and inefficiency on the part of those entrusted with the defense of the state came to hand, and it was generally understood that Russia, at the beginning of the war, was but the hulk of a nation, like a giant without coördination of brain and brawn. If the plans of Germany as to the prompt and decisive defeat of France had not miscarried, resulting in the necessity for engaging in trench siege warfare from the Channel to Switzerland instead of merely occupying the territory, Russia would have crumpled and the war would have been over months ago, with Germany everywhere victorious and with every victory consolidated.

But France was not defeated, for she held Germany at the battle of the Marne and thereby spilled the beans. The full strength of Germany could never thereafter be directed against Russia, the menace to the Fatherland on the east, and with the passing of each month while the Entente found themselves, after such a reverse as Verdun, in particular, opportunity fled further, until *to-day it seems* beyond recall.

From the Russian standpoint, then, France and her stand not forgetting that of the King of the Belgians saved Russia in the beginning, and the demonstration of line-holding at Verdun with the evidence of tiptoe readiness to take advantage of any opportunity for offensive action points very clearly to the fact that France to-day stands as Russia's safeguard, for Germany dares not turn her back.

A Significant Automobile Record

AUTOMOBILE records are without number, and most of these are mainly of value for advertising purposes, but a performance that has just been announced seems to establish facts of general interest to the public in relation to the much discussed question of the dependability of the multi-cylinder engine. Although engines having over six cylinders, which appears to be the accepted line of demarcation between the so-called "simple" and the multi-cylinder machine, have been in use for some time, an impression still exists that the apparent complication of an engine having more than six cylinders is liable to affect its reliability under hard, continuous work, and this is the point that the present test appears to meet and answer in a very practical way.

The test in question was a record run from coast to coast by an eight cylinder car made by one of the first companies to place this type of car on the market. The start was made from Los Angeles at 12:01 A.M. on May 8th, and ended in New York at 2:43 P.M. on the 15th, an elapsed time of 7 days, 11 hours and 42 minutes, allowing for the difference in standard time between the two places, the distance being estimated at 3,380 miles. This makes the daily mileage average about 450 miles. For comparison it may be stated that the previous one-man automobile record, which,

(Concluded on page 564)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Opportunities for South American Trade

To the Editor of the SCIENTIFIC AMERICAN:

I have read with great interest in your issue of April 1st a letter on export trade from a man who very evidently knows the subject. For years I have asked school principals at home why Spanish is not a compulsory study in all schools, and the answer invariably was that they would prefer to see French taught, being the language of politeness. Now it may be very polite to be able to read a French menu and know which is the fish and which is the roast, but there is no money in it. For years our export journals have been thundering "Preparedness" at American manufacturers *and yet I have known hundreds of these manufacturers* who, when approached by the advertising representatives of these journals, would ask, "What is the smallest space I can take?" This oft repeated question exactly typifies the attitude of manufacturers toward export trade. They feel they ought to do something, but they do not want to spend much on it.

My last trip through Spanish America and Brazil has lasted two continuous years, and I have seen so many examples of wasted energy and wasted money that it would be laughable were it not pathetic. Starting at the top, I have met representatives of the Department of Commerce who had to go about with interpreters, because they could not speak the language. I have seen much advertised investigators come down on special missions and stay just a few days attending banquets and making and receiving addresses, then returning to Washington and publishing a lengthy report which, of my own knowledge, was inexact. I could give you dozens of instances of representatives of American firms rushing from one city to another, always in feverish haste, and always lamenting because the Latin will not buy the first day you call on him. Do not let us cry over the sinful waste of money, that is as nothing compared to the *opportunity* we are wasting. When this war is over we will find that the Germans, the English and the French will swoop down on Latin America with methods so far superior to ours that the little we have gained will be swept away in a month.

What the American manufacturer needs to-day—at once—is a central selling organization which will handle the output of several hundred manufacturers at the least cost to each one, but just as scientifically for each. To begin with, each and every clerk and salesman in this selling agency must be Spanish or Spanish American, of proved business ability and selling experience, and the manager must himself be the most perfect example of a Spanish American business man procurable. With the capital back of such an organization it would be possible to establish branch houses of this agency in every commercial center of Latin America, all working in scientific unison toward the common end. If ever such a selling agency is started and managed as I have said, I predict a real conquest of Latin export trade, provided—and mind this proviso—that part of the duties of the staff shall be to keep ears and eyes open for every possible opportunity for obtaining concessions and investments for American capital for railways, mines, and other business enterprises. This must form an important duty of the agency. Every South American traveler will tell you that the railways of Argentine, capitalized in England, prefer to buy of English makers. The few French railways give preference to French goods, and the hundreds of German capitalized companies want to see the "Made in Germany" stamp on all they buy. Let us, therefore, show our capitalists how to invest in Latin America, and breed in them the same loyalty for American made goods. Then we shall have secured, almost automatically, outlets for our goods hitherto undreamed.

I have read that a so-called export expert has said that the day of long credits has passed never to return. It will return the day after peace articles are signed ending the European war. In this connection we have need for American capital to establish banks of discount at all the important commercial centers in these countries. I do not mean the "branches" of a well known American bank. These are well enough in a way, but they have not really helped export business. What we need is an immense central bank with branches in each city, which will guarantee credits. Then an American house can grant the long time credits that are usual here, but only after this credit has been approved by the local branch bank. Once such approval is given, the American house presents proofs of delivery, receives cash payment at once from the bank, less a commission, and the bank takes charge of collecting the bill when due.

A few years after such a central bank has been in working order it would be possible for that institution to present to these southern republics a plan whereby that central bank shall issue all the currency to be used by all the republics, thus insuring a fixed rate of exchange for all and a remarkable falling off in revolutions. It is the power to keep a printing press working overtime turning out bank bills which makes the revolutionist willing to risk his life to get at that printing press.

Caracas, Venezuela. E. C. DE VILLAVERDE.

A River of Mud

To the Editor of the SCIENTIFIC AMERICAN:

It was my pleasure to be one of a party which made a trip into what is known as "The Smoky River Region," northern Alberta, Canada, during the fall of 1915. The Smoky River has its source on the north side of Mt. Robson, thence flowing north into the Peace River. Little of the country tributary to it has been mapped, and but few portions even explored by the white man. However, judging from the well worn trails drying racks and tepee poles, the Indian lived and hunted this section in days gone by.

While traveling down the most southerly branch at the head of Rock Creek (which heads against the Sulphur, a tributary of the Smoky) we crossed a most unusual stream, one so different from the common conception of a stream as to be of some scientific interest. Briefly, we came upon a "River of Mud."

Accepting the evidence obtainable on one visit, this river is composed, year in and year out, of a mass of mud. With its origin on the mountainside, it is presumably fed by the spring slides, kept moist by the summer rainfall, and frozen solid in winter. It may thus be likened to an ordinary water stream, many of which likewise have spring and summer periods and which cease flowing during the winter freeze. In its movement it is more like a glacier in that its motion is so slow as to be imperceptible. That it does move is not to be questioned, as its path through the thick timber is very marked, and along its edge are to be seen some of the trees it has cut down and carried along. Unlike a glacier, there is no terminal moraine. A glacier at its foot, melts and flows away leaving an accumulation of rocks, but any heavy masses that may be in this river of mud must settle to the bottom and remain concealed by the mud itself.

This mud river debouches on a flat, spreading out fan like, and indeed the entire flat at the forks of Rock Creek gives evidence of having been formed from this and similar rivers. The flat is well covered with muskeg, with many islands which were quite likely formed by mud waves such as were observed, for example, when the Hunts Point (Bronx, N. Y.) fill was being made recently.

We were sorry not to have time in the examination of this curious river, but the primary object of our trip was big game rather than scientific knowledge. I did, however, make a sextant reading, computing the approximate location as 53-29′ N. lat., 118-35′ W. long.

Upper Montclair, N. J. C. S. RINDSFOOS.

The Sugar Beet and the Gasoline Situation

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of April 29th there was printed an article on Denatured Alcohol as a Substitute for Gasoline by Stanley Pike. I wish, with your permission, to make a few comments on this article, not in the way of criticism, but to supplement it slightly.

I have been very much interested in this question of a substitute for gasoline, and have believed for a long time that alcohol was the best thing in sight. Even aside from the use of alcohol in motors there are so many ways in which it may be utilized in cooking, in lighting, etc., which are well known abroad but which have not been developed here, that a demand is sure to be created in the near future.

In Mr. Pike's article the statement is made that the sugar beet will probably never be used as a source of alcohol because the American farmer will not go to the trouble of cultivating it. Here I wish to disagree a bit. Let me explain. It seems to be one thing to cultivate beets for sugar and quite another to grow them for alcohol. The sugar beet is a forced product, some four generations of intensive culture being necessary to produce the seed. Beets grown under the best circumstances will have a sugar content of 12 per cent, or even more, but when neglected the sugar content runs down very rapidly. The beets for sugar are planted thickly, then thinned out when they come up, the weeds being removed by cultivation, then when the beets are larger weeds must be removed by pulling them out by hand. This is back breaking work and the farmer either hires it done, which much reduces his profit, or else does the weeding himself, which lessens his enthusiasm for that kind of a crop. Now if beets are given less intensive culture the sugar content will run down, to be sure, but sugar is not necessary for making alcohol. Starch will make alcohol just as well, and even cellulose will do, and both of these are present in the low grade beet. To make alcohol from the low grade beet requires a slightly different method of procedure. The beets are cooked under pressure with a slight amount of sulfuric acid, a method well known to the potato alcohol makers, and the starch and to some extent the cellulose will be hydrolyzed to form glucose, which on fermentation gives us a larger amount of alcohol than could be obtained from the juice of the high grade beet. It seems also that if the industry were developed the cultivation of a low grade beet would be even easier than the cultivation of potatoes.

I agree with Mr. Pike that there is no better way to bottle up energy than to take it from the sun's rays, and I think these rays can be caught very profitably by the leaves of the low grade sugar beet. If Mr. Ford is looking for a cheap motor fuel, why not try a few experiments with alcohol grown from sugar beets right there in the home of the sugar beet?

Hamilton, N. Y. R. B. SMITH.

"Strays" in Wireless Telegraphy

To the Editor of the SCIENTIFIC AMERICAN:

I noticed in a recent issue of your paper two articles which I have read with interest, one is on the subject of "strays" in wireless work, and the other on an experiment where a shingle was used on a phonograph as a reproducer.

I have experimented with a wireless and many other instruments concerning the so-called "strays." I noticed that it was mentioned in that article that these strays had been noticed simultaneously at two stations a long distance apart. I have found these "strays" stronger in the summer and on stormy nights than any other time. I have many times during a heavy snow storm drawn a steady spark or stream of sparks from my aerial. At other times, when the air was very clear and cold (about zero), and I could not hear "static" to any extent ordinarily, I could "tune to" the station at Key West and hear much "static." I could do this with many of the stations in the South even though they were not working, merely by "tuning to" their wave-length. I concluded that "static" storms were in progress at these points and that in some manner I was enabled to hear these by "tuning to" their waves "reflected" from the aerials.

As to the phonograph experiment, I have performed many interesting ones with a phonograph record, but one of the most interesting is that of changing the sound vibrations directly to electrical waves. Take an ordinary telephone transmitter and solder a phonograph needle to the outer shell perpendicular to the tangent of its edge. Connect the transmitter up to a pair of receivers in the ordinary manner, using three cells (dry) in series with the transmitter and primary of an induction coil. Connect the phones to the secondary. Let the needle rest lightly on the record while running at ordinary speed, and the music will be heard in the receivers as loud as common and much clearer, no "diaphragm and horn" sound being heard. These can, of course, be amplified with an audion or other amplifier and reproduced at a distance with a "loud talker."

Milroy, Ind. HUBERT MCILVAINE.

The Federalization of the National Guard

To the Editor of the SCIENTIFIC AMERICAN:

One of the arguments thrown at the undecided and semi-informed general public by the enemies of reasonable preparedness was editorially quoted in the SCIENTIFIC AMERICAN of recent date, i. e., the federalization of the National Guard a menace to the country.

Before seeing the statement in your columns that the federalizing of that body was one of the greatest dangers that this country now faces, the writer had supposed the idea merely one of the links in the chain with which the "Too proud to Fight" people hope to fasten the Dove of Peace to the American Eagle.

The injustice done the members of the organized militia by even the thought of the possible gigantic political machine is incalculable, and certainly does not but add to the number of barriers in the rough path over which they must needs travel.

The National Guard is composed of men, who—in place of ambling along proclaiming to all who will listen that "one citizen of the United States could down at least three of any other nation or group of nations," does his bit of studying and drilling, realizing, as his noisier fellow (citizen?) does not, that there must be an end to everything, even notes of protest.

So they actually believe that a man with gumption enough to stand the gibes of these pests would lower his personal standard, or that of his organization, to become the tool of a politician!

What's past is done; what the future holds none can discern, but why not help nail the Stars and Stripes to the mast instead of sawing at the halyards?

R. M. D.

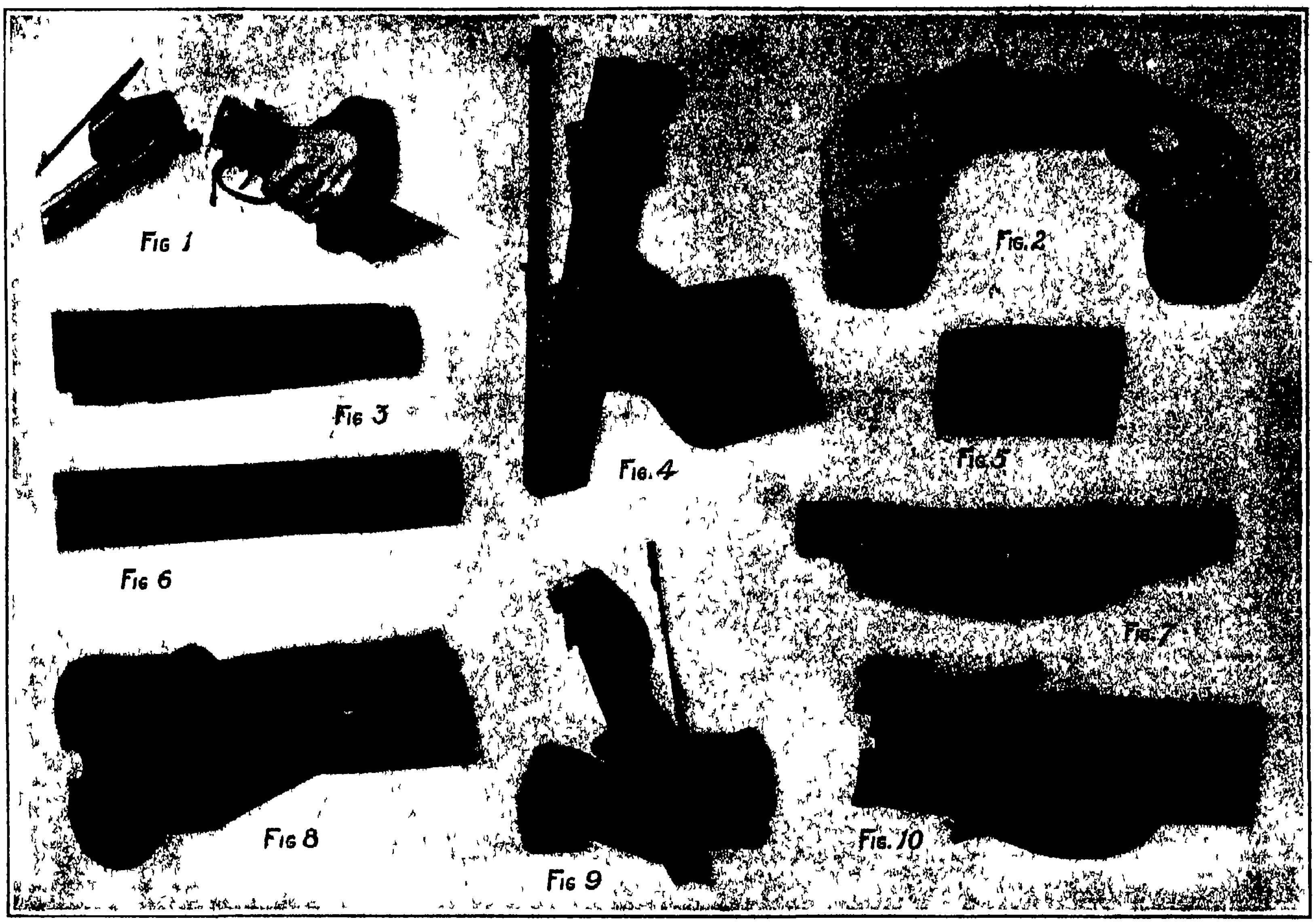


Fig 1—The wreck of a three barreled gun blown up with 60 grains of dense smokeless shotgun powder, which easily could have been loaded by error through a measure set for the standard load of "bulk" smokeless Fig 2—A freak blowout showing weakness of old style Damascus barrels Gas burst out in two portions of barrel choosing weaker portions and leaving intact stronger ribbon between. Fig 3—Portion of 28 bore barrel blown out through overload in chamber Fig 4—Not a pleasant thing to occur when one is holding the gun Fig 5—The chamber end of a double gun, blown up by overload Figs 6 and 7—What happens when an obstruction is in barrel Fig. 8—The breech of a three-barreled gun, blown up by the writer The rending force of the overload of dense shotgun powder blew the "flats" off the heavy frame in addition to blowing the barrel wide open Fig 9—This barrel was blown up from some unknown cause, but unquestionably an overload. What would have happened had hands been around the torn portion? Fig 10—The heavy breech end of a barrel in which 60 grains dense smokeless was fired, apparently akin to a detonation shot also broke off frame and blew hinge portion out of sight.

How Guns Are Blown Up

Destructive Effects of Overloads of Powder and of Obstructions in the Barrel

By Edward C. Crossman

OUT of ten guns that blow up, nine are probably shotguns Out of the nine, eight let go without harming anything but the feelings of the shooter However, the one chance in ten blowups for injury to the face or the fingers, when taken over the great bulk of guns sold annually in America, is sufficient to make worth while some dissemination among the proletariat of advice against the things that lead to the wreck of what was once a perfectly good gun and a perfectly good left hand

Probably 90 per cent of the guns that blow up are blown up through obstructions in the barrel Five per cent of the ten left are blown up through errors in loading the cartridge, often the errors of the shooter himself Shotgun barrels, through consideration of weight and balance, are lightened nearly to paper thinness forward Shotgun powders are tempered to the shorn barrels by being made to exert their great pressure in the first 10 inches of the tube, where there can be left a fair thickness of metal without prejudicing the balance of the arm Where the chamber pressure of the 12 bore gun with normal load may run four long tons or in round numbers, 9 000 lbs per square inch, at a point two inches from the breech of the gun the same pressure fades away to about 400 lbs. at the muzzle

While shotgun barrels of entirely normal proportions have been tried with gradually increasing loads until the pressure stood 40 000 lbs per square inch, or four times any normal pressure yet the forward section of the barrels so tried received no proportionate part of the excess and their strength remained still in doubt. They bulge or burst readily from obstructions, whereas prodigious overloads can be employed without affecting them, merely because overloads do not greatly run up the pressures well forward in the barrel When a charge of shot or a bullet moving down a gun barrel meets with an obstruction weighty enough to check its progress, usually the result is a barrel either bulged or burst If the obstruction is pushed down to rest on the shot or bullet before the shot is fired, there is usually little effect. Hence the rise of the compressed air theory as the explanation for the damage done No room between missile and obstruction, no blowup, save when the obstruction was made very heavy Room between them, result either bulge or burst. As a matter of cold fact, of course, the barrel is far stronger at the breech, and so such tests are of little value as not throwing the strain on a part of the barrel weaker than that at the said breech However, the same phenomenon was observed in barrels of the same thickness throughout, and it became evident that to damage the barrel, the shot or bullet had to get a running start on the obstruction

Years ago, British authorities held that the air, compressed 'twixt missile and obstruction, did the damage The argument waxed hot, and the great British sporting paper, the *Field*, set pressure plugs along a barrel and apparently determined the fact that the highest pressure fell between missile and obstruction, not behind the missile, where the powder gases were pushing

It was probably from this that the silly theory, so commonly accepted among shooters, took rise, this, to the effect that if you "sealed" the bore of a gun you would blow it up at the next shot Needless to say, a gun can be sealed with gold beater's skin, with sealing wax, or with a thin film of mud, not one of the three possessing any resistance so far as weight or grip on the bore is concerned A thin bridge of snow across the muzzle of a shotgun is held by the superstition of the shooting clan to be sufficient to blow up the gun.

As a matter of fact, if the tube contains two inches or so of well packed snow from a fall or careless handling of the gun, to the eye the effect is the same as if it were sealed with a thin film of the same substance, and the two inches of packed snow is quite ample to blow up the gun. Hence well authenticated instances of a gun bore merely "sealed" with snow blowing up, and the perpetuation of the gray whiskered theory

In my destructive career I have blown up many guns in the endeavor to see what makes 'em tick, and I have taken occasion many times to seal the bore of the condemned weapon, preliminary to other doings at this auto da fe, and to fire it to see if it would let go In no case did the weapon burst or bulge the barrel from less than a fair amount of mud or other weighty substance, regardless of how carefully the air in the bore was segregated from the air outside by a careful seal In the case of a service rifle of the Government, the New Springfield, we rammed the muzzle into a mud bank until the bore was most assuredly sealed, and contained an unknown surplus into the bargain It blew out without harm to the bore Only after we rammed it repeatedly into the mud, sufficiently to accumulate an inch or so of sticky mud, did the barrel burst, and then it split from muzzle to breech in two neat halves, as if one had sawed them with a hacksaw

While the barrel is far stronger at the muzzle than is the barrel of the shotgun, the pressure also is far higher than is that of the shotgun, and the bullet arrives at the muzzle with the cruising speed of more than double the charge from the fowling piece. Less mud would have blown up the shotgun, but not merely enough to seal the bore In other words, what blows up guns is weight of obstruction.

Ballistic engineers believe that guns are blown up through a violent wave action of the rushing powder gases, suddenly checked at the obstruction, and having almost the effect of a wave of detonation. There would seem to be a limit to the force than can be exerted by the compressed air, while within the strength of the gun barrel there is practically no limit to the strength of ordinary gunpowders. A single pound of modern bulk smokeless shotgun powder has the potential energy of 19 foot tons. That is, enough to raise 19 tons a foot.

Almost without exception a gun will blow up if it has its muzzle pushed well into a pool of water. Here, of course, the resistance of the water in the barrel, a non-compressible substance possessing weight, is akin to that of more solid substance. In the trench fighting

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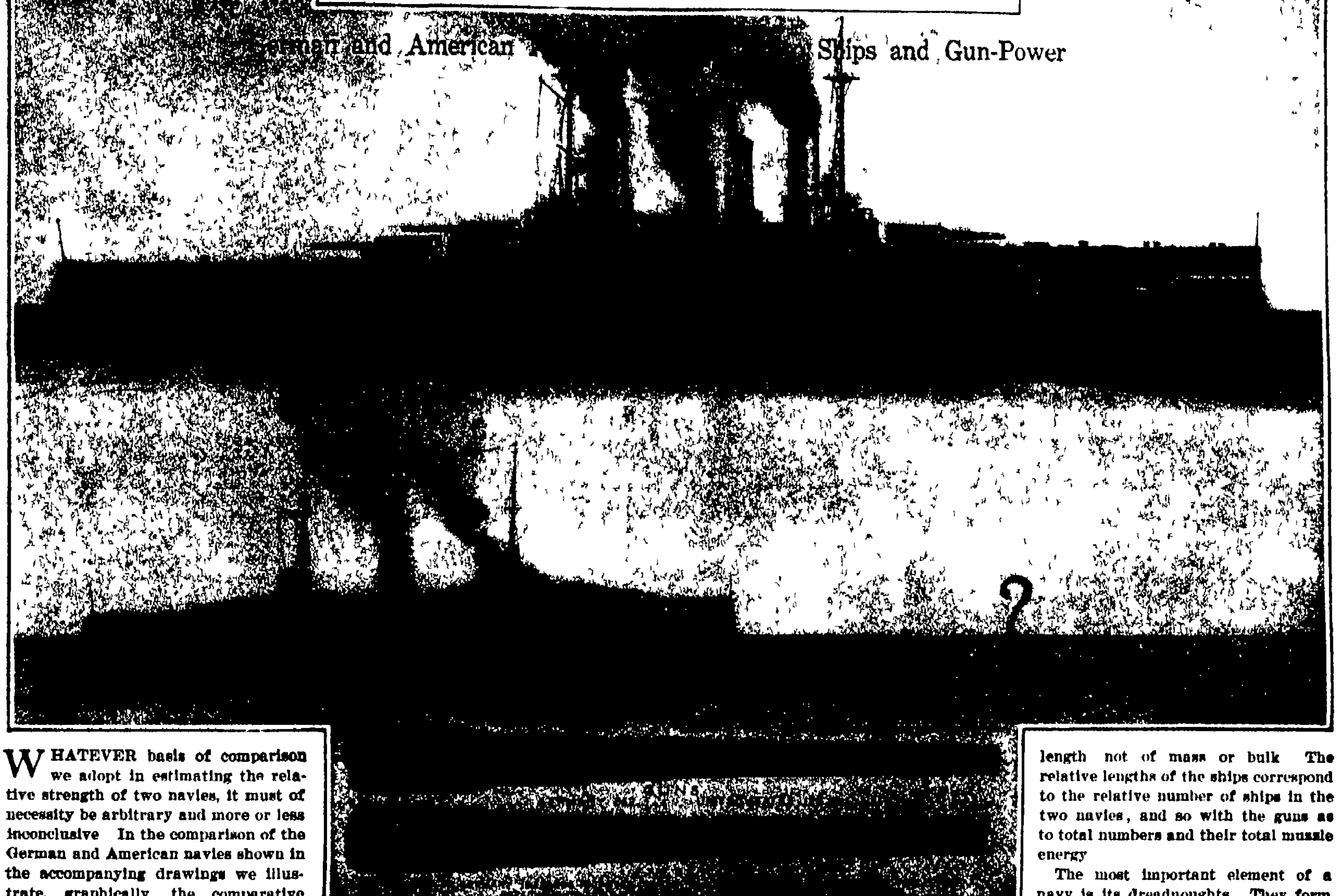
Why America Lost Second Place

German and American Ships and Gun-Power



The relative lengths show the relative strength of the navies in dreadnoughts, and in their guns and gun energy

WHATEVER basis of comparison we adopt in estimating the relative strength of two navies, it must of necessity be arbitrary and more or less inconclusive In the comparison of the German and American navies shown in the accompanying drawings we illustrate, graphically, the comparative strength in number of ships, in number of guns, and in total gun energy At best, this is but a rough and ready method, for to judge of the value of numbers we should know something of the size, speed, defensive qualities, fuel capacity, and ammunition supply of the individual ships, the distribution, arcs of fire, availability to train on either beam, and the weight and penetrative power of the individual guns

To make an exhaustive study of the subject along such lines would be beyond the scope of the present article, but by way of suggesting what modifications of the mere totals given in our drawings would have to be made, we draw attention to the fact that although the German navy includes 26 completed dreadnoughts as against 12 completed in the United States fleet, the average displacement of the United States dreadnoughts is 25 per cent greater That is to say, the average displacement of the United States dreadnoughts is 25,625 tons as against only 20,550 tons for the German dreadnoughts.

Now, unless some grave errors have been made in her design, a ship that is of 25 per cent greater displacement, is presumably 25 per cent more efficient than the smaller ship The excess displacement will appear in a more powerful armament or more complete defensive elements such as thicker armor, or in both, or it will be seen in a larger fuel and ammunition supply, or in a more powerful motive power and greater speed Hence we believe that ship for ship and date for date, our own dreadnoughts are more than a match for the dreadnoughts of the German navy Given equally good handling and equal gunnery our "Pennsylvanias" and "Nevadas" should be more than a match for any of the German dreadnoughts, with the possible exception of the three latest ships of the "Ersatz Worth" class.

On the other hand, we wish to draw particular attention to the fact that Germany possesses in her battle-cruisers alone a division of ships capable of making from 28 to 30 knots, which would be a sore puzzle to the commander-in-chief of our relatively slow, 21-knot dreadnought fleet. He would be powerless to bring them to action, they could sink any of our slow and insufficiently armed scouts we might send out to find the enemy, they could obtain full information of our movements without the least risk to themselves, and, if they elected to sink our merchant ships and raid our coasts, they could do so with impunity

In the event that the German fleet brought our own to a general action, their numbers and the possession of a fast battle-cruiser wing would render the outcome of the action a foregone conclusion—always, of course assuming that the maneuvering and gunnery were of equal quality It is conceivable that our battle-line of 12 ships might find itself engaged simultaneously by a line of ten German ships on each beam And the six battle-cruisers, by virtue of their high speed, could take position ahead of our line and by steering a zig zag course would be able to concentrate their broadsides against the head of our line. Thus, at the same time, our leading ships would be subjected to the concentrated fire of the whole 26 ships of the German fleet, and under that tornado of high explosive shell, the head of our line would melt away like a bar of wax before a blow pipe

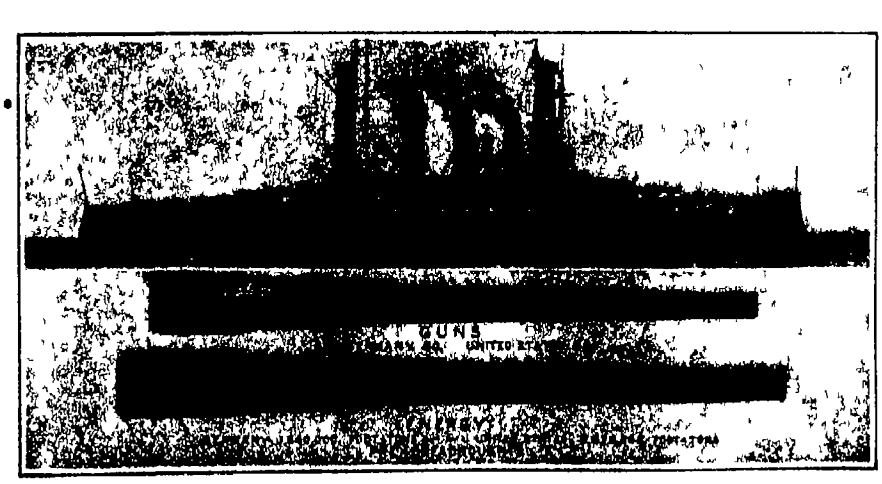
Referring again to our illustrations, it must be borne in mind that the comparisons are made on a scale of length not of mass or bulk The relative lengths of the ships correspond to the relative number of ships in the two navies, and so with the guns as to total numbers and their total muzzle energy

The most important element of a navy is its dreadnoughts. They form the first battle-line and no judicious admiral will think of pitting his pre-dreadnoughts against an enemy's dreadnoughts. The winning of this first line battle will in all probability mean the winning of the war How then do we stand in respect to that navy which only a decade ago we surpassed in strength by a good margin?

Germany possesses 26 dreadnoughts, mounting 262 armor piercing guns, whose total energy is 13,226,000 foot tons, and against this mighty fleet we could oppose 12 dreadnoughts, mounting 128 guns, whose total energy is 7 417 736 foot tons. And let it never be forgotten that against the six battle-cruisers included in that fleet, we could oppose not a single one

When we come to the second line composed of pre dreadnoughts, the comparison is more in our favor, but lest we deceive ourselves (and it is to be hoped that our Congressmen will take careful note of the fact) we must carefully bear in mind that it is the dreadnoughts that will decide the naval campaigns of the future Germany possesses 20 pre-dreadnoughts, mounting 80 armor piercing guns (though it is doubtful if the 9 4 inch guns of the "Kaiser Freiderich III" and the "Willesbach' classes should be called "armor piercers"), of a total energy of 1 640,000 foot tons Against these we could opose 22 ships, mounting 96 guns of far greater power whose total energy is 3,870,545 foot tons Among the pre dreadnoughts we have included the 'Michigan" and "South Carolina whose small size and low speed shut them out of the dreadnought class

The great disparity in the gun power of the two pre-dreadnought fleets is due to the fact that we started out right by mounting heavy 12 and 13 inch guns, whereas the Germans fell into the error of mounting light 9 4 inch guns in the belief that volume of fire was of more value than weight of fire



Relative strength of German and United States navies in pre-dreadnoughts and in their guns and gun energy, shown by lengths of guns and ships

Molasses as Fuel

A GREAT Hawaiian sugar company has arranged to ship waste molasses to the Pacific coast where it will be burned as fuel and compete with California fuel oil It would seem possible to ferment this molasses into alcohol and manufacture this product at a profit.

War Game—XI

The Defense Against a Landing Body

By Lieut. Guido von Horvath

THE principles of the offensive and the defensive tactics remain the same no matter what kind of an action is considered. One party will attempt to force its will on the other. Against this attempt the second party will offer its best resistance. If this proves to be successful the second party will undoubtedly undertake the same action to which he has just seriously objected. This means in plain English that "thou shalt do unto your neighbor what he intends to do unto you—but do it first."

In our present case the main difference rests in the fact that new elements are introduced hitherto not considered in our problems. These new elements are the sea and its shore as the field of action, war craft, which represent the effective and mobile artillery forces of the enemy, and transports which carry the troops with the intention of landing them on the shore under the protection of the guns of their fleet. These last become the fighting forces as soon as they are landed. But until that moment they remain the most vulnerable part of the enemy.

A landing operation in face of a defensive force is one of the most difficult problems war can present. For this very reason whenever a landing is to be attempted this attempt must be undertaken in great secrecy. Should conditions not permit this, it will depend for its success on the ruses and feints employed to hide the real purpose.

Primarily the defense of a coast line is the duty of the navy. So long as our own navy is afloat and able to cope with the enemy, the chance of a hostile landing is very small. Even if an enemy could establish itself on shore, its communication would be in constant danger. Its supplies could not be continuous and sooner or later the land forces would be forced to surrender. Therefore the navy must be accounted for before a successful landing can be made.

Now let us consider the vast coast line of the United States and let us study the points which would be most likely to play a part in warding off an enemy landing.

It is but natural that as soon as war is declared a coast guard system will be established to serve as a precaution against surprise. The established coast defenses must see to it that commercially and strategically important harbors are well guarded by mine fields and where necessary, by temporary field fortifications.

It is safe to presume that any operation directed against the coast line will threaten some important point. A thrust against the heart is the first rule of strategy but often the indirect road leads to the aim quicker. Therefore while a demonstration against the most important point is to be expected the real blow might fall at an altogether different point.

Keeping this in mind, it is assumed that the line of observation along the coast will be continuous. With the aid of scout cruisers naval patrols, aeroplanes and captive balloons this ought to be a trustworthy line of security against surprise.

Besides this temporary arrangement, we must remember the regular land forces of the Coast Defense. These are the local military forces assigned to important harbors and fortifications.

The military preparations for the successful defense of the coast line of a country are the fortifications, the arrangements for rapid troop movements and the organization of forces to cover the entire coast line.

The fortifications are either permanent establishments or field works erected for the defense of important points.

For the transportation of the land forces all the available railways and other means by which the defensive troops can be quickly placed at the point of need must be utilized.

The organization of forces at strategical points demands a sufficient army to cope with the situation.

The main defense against harbor attacks is the Coast Artillery. These armaments are located in permanent fortifications where earth, concrete and steel works are used to protect the guns. The armament of the permanent fortifications consists of the first class, intermediate and the second class guns. The last two classes are generally rapid fire guns.

The first class armament includes the large caliber guns and the mortars. These are designed to attack armored vessels with their shot and shells and to disable, destroy or sink these vessels through the high explosives which such shells carry. The shot is intended for use against the main armor of a war vessel. Through its heavier construction it has greater penetrating power, and it acts as a mine. Shot has no fuse but explodes through the sudden force of impact against the armor plate.

The intermediate class consists of guns from 4 inch to 6 inch caliber. Their purpose is the protection of the mine fields and the attack of unarmored boats.

The secondary armament is the 3-inch gun, and on account of its mobility is of the greatest importance.

Besides the guns and ammunition necessary for efficient coast defense, the fire control power and light equipments, the wireless and signal communications are of great importance.

Map of Nehaminy Bay and vicinity

Gunnery in our days is a highly developed, scientific engineering feat, which demands the highest training in both men and officers.

The groups of guns placed in certain fortifications or their parts are known as "batteries." Several batteries, seldom more than three or four, are placed in the control of one officer and are designated as "fire commands."

We have here given an introduction to the new elements of warfare. We can therefore work out a problem of defense against an attempted landing by the enemy.

General Situation

July 15, 19—

After an indecisive naval engagement in the north, the Red fleet withdrew toward its base. The Blue fleet, by scout cruisers and aeroplanes, has ascertained the fact that the badly damaged cruisers of the "Alexander" class have reached port and remained there, but that the first battle squadron of Admiral A, with the dreadnought "Achilles," having coaled and provisioned, steamed away toward the northwest, and has been in wireless communication with a northern fleet, the strength of which was at that time unknown.

The Blue fleet, consisting of the 4th squadron under Rear Admiral RA, put in at the Sullivan Bay coaling station and, having placed the "Icharian" into dry-dock, received the news that the 2nd squadron, with two dreadnoughts, was moving south to establish communications.

On the 10th of July, 19—, the Blue scout cruiser "Virgo" intercepted a wireless message from the Red fleet, which indicated that Admiral A's squadron sighted the northern Red fleet and that the fleets in a combined route are ahead toward Sullivan Bay. That same day an aerial scout of the Blues, flying at great altitude, sighted this combined fleet and returned with the report that the Red fleet was accompanied by transports.

That same day, at noon, the northern Blue squadron dropped anchor in Sullivan Bay.

In the afternoon, through another aerial reconnaissance, from the 4th squadron's fast cruiser "Menelaus" the wireless report repeated the news above given. Whereupon Admiral XA, commanding the entire Blue fleet, issued orders to steam against the oncoming Red fleet.

At 7 P.M. the Blue squadron sighted the Red fleet in battle line. A combat at long range followed. The Red fleet suddenly gave way turned north, drawing the Blue fleet in its wake.

The approaching night ended the long range encounter and the Red fleet steamed out of sight of the Blues.

Nehaminy Bay is located 92 miles south of the Sullivan Bay naval station, and is in direct connection with the Capitol, via the Hatfield and Alpine Railroad. Considering the importance of the channel and the deep harbor of Hatfield at the outbreak of the war, two batteries were erected for its protection.

In Pottstown a detachment, consisting of the 9th Infantry Brigade with two batteries of field artillery, one squadron of cavalry and one battalion of Engineers, has been concentrated for coast defense service.

The mining of the channels has been ordered but not yet carried out.

One gunboat of the "Hawk" type, with two torpedo boats and a submarine of the second class, were detailed for service in Nehaminy Bay.

On the 17th of July 19—, the Red fleet was sighted 150 miles north of Sullivan Bay, and another naval battle ensued at 10 30 A.M., in which swift cruisers only of the Red forces took part, drawing the Blue forces still farther north.

At 11 45 the Blue observation post at Thompson's Island reported the approach of a fleet, steaming east.

At 12 30 the fleet came into sight and its identity was established. The approaching enemy fleet consisted of one battle cruiser, a torpedo boat flotilla and three large transports.

From consideration of the course, it became evident to the observing station that the enemy fleet was headed toward Nehaminy Bay. The following telephonic report was sent to General G, commander at Pottstown.

"An enemy fleet, consisting of one battle cruiser, a flotilla of 7 torpedo boats and 3 transports of 4,000 tons each, steamed into sight at 12 30 P.M. Their course indicates the intention of entering Nehaminy Bay."

From these observations and reports it seems probable that the maneuvers of the Red fleet were designed to draw the Blue fleet away and thus give an opportunity for smaller scattered landing parties to gain a foothold on the Blue shore.

General G at Pottstown, having received the report, according to prearranged plans, which were worked out for the defense of Nehaminy Bay, issues the following orders.

"Pottstown, July 17th, 1 P.M., 19—

"A small enemy fleet with 3 transports is steaming

toward Thompson's Island, apparently with the intention of entering Nehaminy Bay and landing forces on our shore.

"To prevent this landing, the detachment will march immediately to a point one mile north of the railway bridge crossing lower Nehaminy River

"The cavalry, with one battery as advance guard, via temporary bridge alongside Hatfield Railroad will occupy Sherwood Hill and patrol the shore north and south for 25 miles

"Fifth Regiment of Infantry will follow immediately and take position in readiness behind Sherwood Hill Second Battery will march with this regiment The 6th Regiment will camp along railway and prepare for immediate embarkment Engineer Battalion will entrain in first train for immediate departure Fifth Regiment to supply flank guards 2 miles north and south of Sherwood Hill

"Communication between the defensive shore line and headquarters will be established by the cavalry, and Colonel C will immediately put himself in communication with Coast Signal stations and the Fire Command at Sherwood Hill

"The ammunition and supply trains will follow the regiment on the Wyola road

"I shall remain with the advance guard

"(Signed) General G

"Commander of Pottstown Coast Guard Detachment"

Naval Developments

When the Blue observation station on Thompson's Island sighted the Red Navy and transports, the Red torpedo boats, in fan formation, slowly proceeded toward the northern entrance of the bay, followed by the cruiser and the transports

The Blue naval forces at that moment were in the following position The gunboat "Eagle" was at anchor behind Thompson's Island, the torpedo boat "Sphinx" was 9 miles north of King's Lighthouse, steaming south, the sister boat "Isis," 2 miles south, homeward bound The F 2, a mile west of Thompson's Island, after a signal exchange with the observation station, submerged in a westerly direction

At 1 25 P M the "Isis" reached the cover of the island and dropped anchor 200 yards south of the "Eagle"

At 1 35 the enemy cruiser fired a shell at the approaching "Sphinx" The range was far too short, and the "Sphinx," with decks cleared for action, keeping close to shore sped full steam ahead Five minutes later another shot fell closer At 1 45 P.M the range was fairly well established by the Red cruiser The "Sphinx" slowed down and steamed slightly seaward. The next shells fell ahead

At 1 55 the "Sphinx" took full speed and in five minutes turned the point at King's Lighthouse and, untouched, entered the bay

The next fire action on the enemy's part was at 2 10, a shell dropped into the bay, but the Blues paid no attention either from the shore or from the gunboat behind Thompson's Island

At 2 40 the enemy torpedo boats on both ends of their line dashed forward, one headed for the northern, the other for the southern entrance of the bay Five minutes later the "Eagle" opened fire upon the nearest torpedo boat—the second shell was a hit and the southern Red torpedo boat was disabled The "Eagle" then steamed slowly up and down behind the island, firing at intervals. When a second torpedo boat was hit the battle cruiser steamed forward and a random shot fell on the "Eagle's" deck, causing serious damage.

Utilizing the lull in the situation, the Red cruiser boldly dashed forward, and ten minutes later reached the entrance at King's Point At almost the same time the first transport was torpedoed by the Blue submarine, but the effect of the explosion was not immediately felt. With the intention of beaching the sinking boat, it was sent forward at full speed toward the shallow waters near the island. Two torpedo boats stood by

The Red battle cruiser, instead of keeping its course toward Murphy's Point, turned close inshore, when the hidden Blue coast battery from Wyola Hill opened fire,

Owing to the small caliber of the coast battery, its guns were silenced in 30 minutes.

(Concluded on page 564)

Guns That Protect Crops from the Ravages of Hailstorms

WHILE the guns of the European armies are thundering incessantly on many battlefields in their mission of killing men and destroying man's works, the

Placing powder charges in the brass shells for the anti-hailstorm gun

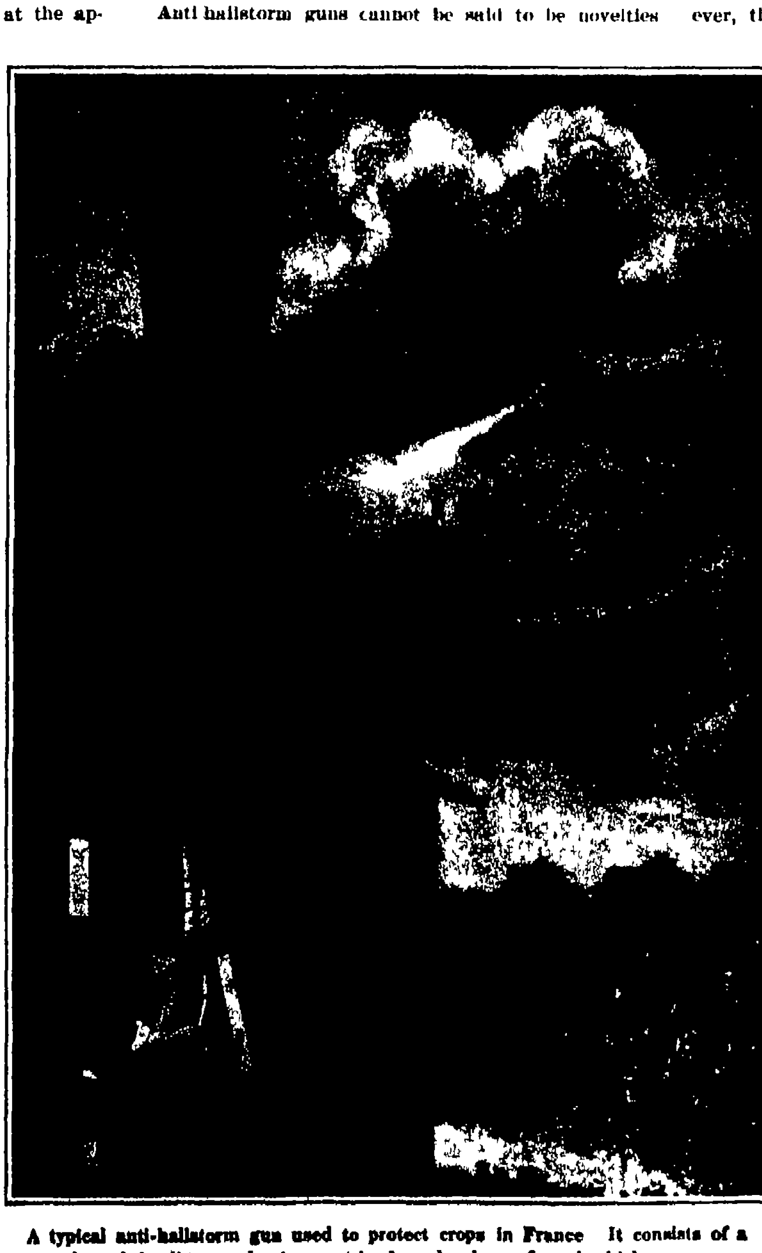
grape cultivators of France, in their turn, are using artillery to good advantage But theirs is not destructive artillery they are using guns only to protect their vineyards against the destructive effects of hailstorms, which are not infrequent in the grape growing districts

Anti hailstorm guns cannot be said to be novelties in the strictest sense of the word, for they date back to 1896 when an Austrian named Stieger who had had an opportunity of witnessing the devastation caused by hailstorms each year in certain districts of his country, conceived the idea of firing a cannon shot at the clouds charged with hail using an artillery piece of special design Stieger learned that as a result of artillery fire, directed against the clouds the threatened storm moved elsewhere before bursting thus saving the crops in the immediate vicinity of the anti hailstorm artillery

A short time later similar experiments were carried out in Italy followed soon after by the introduction of this method of protecting grape vines and cereal crops in France In the latter country the use of anti hailstorm guns has been extended until to day it is in general use, principally in the Bordeaux, Bourgogne, and Champagne regions

A representative type of the anti hailstorm cannon is composed of four main members First a tripod which serves to support the cartridge mechanism second a breech loading mechanism which receives the cartridge and explodes it by means of a striking or firing pin third, a smokestack or funnel which is a continuation of the breech loading member and serves as an outlet for the gases, and fourth a sheet of iron measuring three to four meters (9 to 12 feet) long, surmounting the cannon and passing through the roof of the shed that serves as a shelter for the cannon and its operators

Following the discharge of the cannon, there escapes from the stack or funnel a whirling shaft of air which, according to a French authority M Vermorel brings about certain changes in the atmosphere The condensation produced by the discharge modifies the unstable electrical state of the hailstones that compose the clouds most feared by the agriculturists Whatever may be the merit of these theories offered in explanation of the action of anti hailstorm cannon the fact remains that this odd artillery is serving its purpose well



A typical anti-hailstorm gun used to protect crops in France It consists of a breech-loading mechanism, a tripod, and a large funnel which passes out through the roof of the shelter

The Preparation of Frozen and Dried Eggs

THE frozen and dried egg industry declares a new publication of the Department of Agriculture, is a permanent one because it meets a distinct economic need Many eggs which could not stand long shipments may be preserved as wholesome food by freezing them out of the shell or by drying In the beginning however, there was a natural popular prejudice against the business, which was increased by the ignorance and carelessness of some of the pioneers It was under these conditions that the Department of Agriculture undertook a study of the problem in order to lay the groundwork for a scientific preparation of an extremely perishable product. Some of the results of this study have just been published in a professional paper, Bulletin No 224 "A Study of the Preparation of Frozen and Dried Eggs in the Producing Section."

The eggs commonly used by reputable firms for breaking are small or undersized eggs and dirty, cracked, or shrunken eggs To the trade these are known as 'seconds' They are not to be confused with eggs that are unfit for human use such as the classes known as black, white mixed and sour rots green whites eggs with stuck yolks, musty and moldy eggs blood rings, etc These should be rejected entirely or else used for tanning purposes only Eggs with a bad odor should be rejected absolutely

Careful candling before the eggs go to the breaking room is one of the principal points upon the importance of which the new bulletin insists Careful candling is not only necessary to prevent the use of unfit eggs but it will also prevent the waste of a number of perfectly good eggs which might otherwise be rejected In order to insure that the eggs are well candled the bulletin recommends some system by which the work of the individual candler may be checked Eggs that it is found difficult to grade should be set aside by the regular candlers for examination by an expert Furthermore, the eggs should be graded again when out of the shell for certain kinds of infection can only be detected when the eggs have been broken When grading eggs out of the shell only two grades should be recognized—food eggs and tanner's eggs

The production of frozen and dried eggs is primarily an industry for the egg producing sections Many eggs that now reach the large consuming markets in a totally unfit condition could be saved and a large portion of the annual waste eliminated if they were treated in time

Inventions New and Interesting

Simple Patent Law, Patent Office News; Notes on Trademarks

Recent Improvements in the Transmission of Steam Through Underground Conduits

WITHIN recent years there has been a tendency in leading cities to replace individual heating plants with central power stations from which heat and power can be supplied to a large group of buildings In many instances these central power stations distribute the heat to a number of consumers by means of hot water or steam passing through conduits laid beneath the streets, much in the same manner as the supplying of water and gas But there is this difference, however that in the instance of either hot water or steam the problem of conveying the heat involves a number of additional problems prominent among them the provision for expansion and contraction of the pipes and the maximum of insulation in order to minimize the loss of heat incurred in conveying the hot water or steam for any distance

A Southern manufacturer of clay sewer pipes has lately evolved improved forms of conduit and supports for the proper installation of steam or hot water pipes beneath streets in cities, or under ground in country districts and in connecting various buildings of a factory group For the sake of clarity, the conduit he has developed will be considered as consisting of two main members, the conduit proper and the supports within the conduit, which hold the steam or hot water piping

The conduit is made and shipped in complete sections the same as sewer pipe, but the sections are provided with open, dipping scores on the inside and outside at two points diametrically opposite The sections still intact are distributed along the conduit trench and then rattled into halves with a hammer Along and beneath the outside scores is a joint shelf for the retention of cement when assembling the companion halves, after the lower part has been laid and the heating pipe put in place upon the supports. *For identifying* the companion halves, suitable means of marking them are employed

On all but very small pipes the supports are placed 10 feet apart. This introduces either three or four intermediate sections which have no means of holding pipe supports between the supporting sections The number of intermediate sections depends upon whether the sections are 24 or 30 inches in length, or whether the pipe is so small as to require the supports to be less than 10 feet apart to prevent sagging

The support sections of conduit are provided with two interior right angled longitudinal ribs in the lower half that *is to say, in the half carrying the joint* shelves The upper faces of these ribs are in the same plane the other faces are parallel—standing vertical when the upper faces are level—and the ribs are far enough apart to give an ample roller base to safely support the sizes of pipe to be carried The ribs are placed at a height which, added to the height afforded by the support holds the pipe far enough above the bottom of the con

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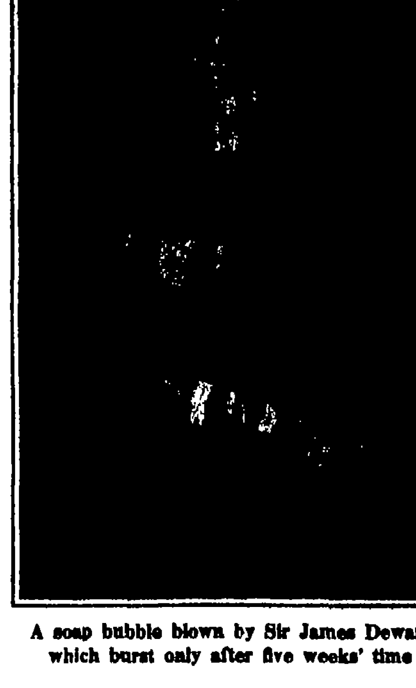
A conduit for the conveyance of steam, showing the expansion compensating supports



A soap bubble blown by Sir James Dewar, which burst only after five weeks' time

Soap Bubbles That Last for Months

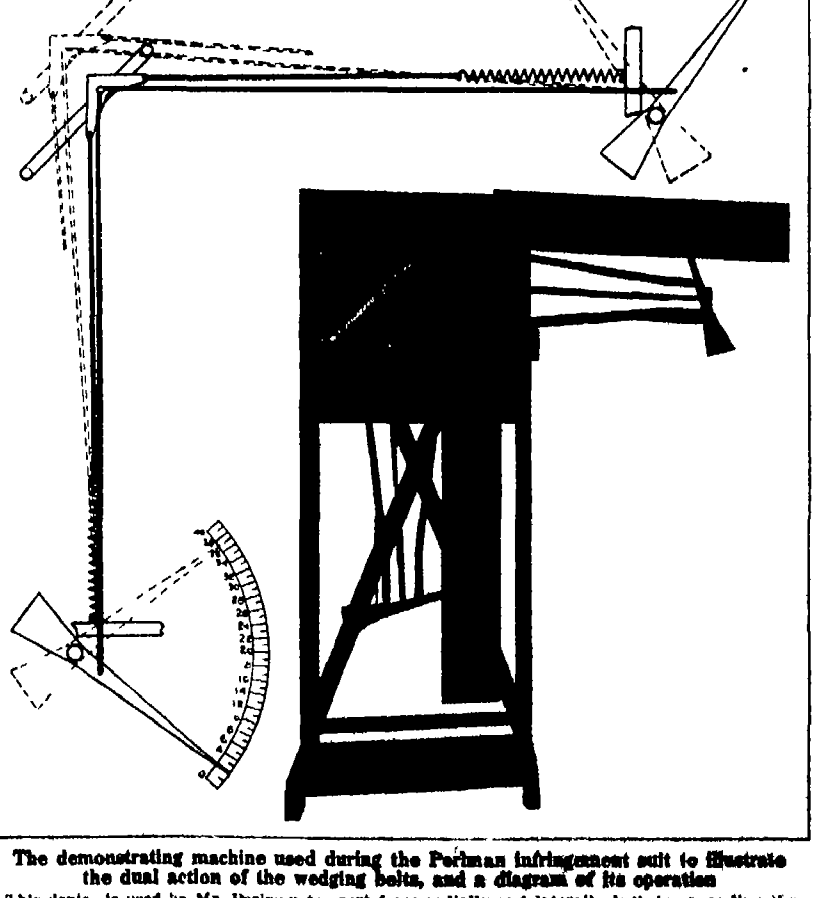
SIR JAMES DEWAR, the famous scientist whose name has been closely associated with work on the liquefaction of the so-called permanent gases, researches at temperatures approaching the absolute zero of temperature, and the introduction of vacuum jacketed flasks for the storage of liquid gases—the Dewar flasks which were the forerunners of the vacuum bottles of everyday use—has been conducting a series of remarkable experiments with soap bubbles at the Royal Institution of London

Unlike the ordinary soap bubbles whose life is rated in seconds or possibly in minutes, the soap bubbles produced by Dewar last for several weeks or months In a discourse on 'Problems in Capillarity" it was desirable to use the thinnest possible membrane, for which purpose 'black" soap film was selected By the term "black" it is not meant that the film is black in color; quite to the contrary, it is perfectly transparent, although it appears black in reflected light. The question arose whether soap bubbles were intrinsically unstable or whether they merely collapsed because of contamination by either the liquid used or the air By way of answer Dewar placed a bell jar 9 inches in diameter on the lecture table, and near the bottom of the jar placed a "black" soap film to form a perfect horizontal partition A bubble was then blown inside the bell jar

On Friday evening, March 24th, after a record career of more than five weeks, the soap bubble burst. It had been on exhibition at the laboratory of the institution and attracted a large number of visitors. It is believed that the bubble would have lasted for a much longer period had it not been for the vibration of the laboratory engines producing liquid air Dewar has blown other soap bubbles which have had unusual life

How an Inventor Successfully Conducted an Infringement Suit

THE final adjudication of the Perlman patent covering a demountable rim is encouragingly illustrative of the present trend of the bench. The patent was originally filed on May 21st, 1906, and was continued by a subsequent application made on the 29th of the month following The patent was granted only after nearly seven years of argument and reargument in the United States Patent Office and the United States Circuit Court of Appeals of the District of Columbia, and finally issued on the 4th of February, 1913. It took that period for the inventor, Louis H Perlman, and his attorneys to enlighten the official mind and satisfactorily to demonstrate that certain seemingly simple structural features were capable of producing novel mechanical effects The puzzling aspect of the matter is the involved commercial conditions arising from the fact that many thousands of demountable rims for automobile wheels were in service before Mr Perlman's patent issued in 1913. Millions of dollars were actually invested in the manufacturing plants engaged in turning out these up-to-date aids to convenience and pleasurable touring



The demonstrating machine used during the Perlman infringement suit to illustrate the dual action of the wedging bolts, and a diagram of its operation

This device is used by Mr Perlman to exert force radially and laterally both in expanding the rim on the wheel and in locking it laterally to prevent displacement. No matter whether the operator of the machine slides frame 4 sidewise or vertically, the two indices give the same reading, thereby indicating that deliberate effort in one direction exerts through the wedge member a force of identical measure in a direction of right angles.

When Mr Perlman's patent issued three years ago, he found that he had a hard road commercially ahead of him even though the courts had sustained the originality and the priority of his invention in all particulars Legally, he had a controlling patent, but even so he had to fight to win the fruits of his ingenuity Therefore, he sued the biggest concern engaged in the manufacture of demountable rims Suit was entered in October of 1913, and not until the 8th of March of the present year did the courts finally uphold the patentee and issue an injunction against the infringer The long-drawn-out prosecution of the patent in the United States Patent Office and the protracted contest in the Federal Courts cost the inventor heavily, but he was convinced that he would win in the end, and therefore made sacrifices and battled on undaunted.

From a technical standpoint the conduct of the suit, especially in its concluding stages, has been both instructive and interesting because of the [illegible] manner in which it was handled. It was

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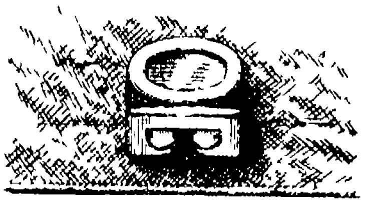
RECENTLY PATENTED INVENTIONS

These columns are open to all patentees The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

HOOK AND EYE F R TILTON JR care of J S Larkin, 66 E 56th St., New York N Y This invention has for its object to provide a hook and eye which may be locked by pushing the hook within the eye and which will not unlock until the hook is depressed by a tongue which extends therefrom the hook and eye being very simple in construction and without ends which might become entangled in the material to which the hook and eye are secured

BUTTON PROTECTOR —W M BARNES, 681 Tremont St Boston Mass The construction in this case is adapted to fit over a button and pinch the retaining member therefor or the button itself as desired so as to protect the button against accidental breakage The



BUTTON PROTECTOR

invention provides a protector for buttons formed with a slot merging into a recess which accomodates a button the protector being adapted to prevent the accidental breaking of the button when beating a garment carrying the button

HOSE SUPPORTER.—C J HAUSEN, 368 W 50th St., New York, N Y The object of this invention is the provision of a new and improved hose supporter arranged to securely grip the hose without danger of tearing the same and to allow of conveniently engaging the supporter with the hose or disengaging it therefrom

COLLAPSIBLE GARMENT HANGER AND COLLAPSIBLE BRUSH THEREFOR —W M STIEBRITS, 465 Jamaica Ave, Astoria L. I New York, N Y The invention provides a construction wherein the hanger is collapsible or foldable and the brush is likewise collapsible or foldable It provides a construction which may be easily and quickly folded to every space whereby the same is adapted to easily fit in the pocket of an ordinary coat.

BUTTONHOLE.—A I JOHNSON care of The Pacific Knitting Mills Inc, 103 Jackson St, Seattle, Wash This invention provides a buttonhole that will permanently maintain its form and original size during the life of the garment and which is particularly adapted for use in knitted goods or other fabrics which are in themselves subject to stretching and afford a relatively unstable foundation for the stitches comprising the buttonhole

Pertaining to Aviation

HOVERING FLIGHT AEROPLANE SYSTEM —J MCCURRY, 4406 Franklin Ave, Philadelphia Pa This inventor provides an aeroplane system comprising a platform for supporting passengers this platform being suspended from aeroplanes flying in the air and having such movement relatively to each other and to the earth as to enable the platform to hover in the air By this means passengers supported by the platform are maintained if desired at a particular point for a long time

Electrical Devices

SOLENOID SWITCH —E GENGENBACH care of Shore Instrument Mfg Co, 555 W 22nd St New York N Y The invention relates to an electromagnetically operated switch and more particularly to solenoids of the iron clad type It simplifies and improves the operation of the devices referred to so as to be reliable and efficient in use and so designed that the housing in which the solenoid is mounted may be made of sheet metal

ADVERTISING DEVICE AND THE LIKE —H K HARRIS Park Mansions Knightsbridge London England The present invention relates to means by which an apparatus which is termed a selector and which is provided in connection with each frame or the like at the exhibiting station is set according to requirements in such a way that when the band or other equivalent device in the frame is set in motion or released it is automatically stopped by the selecting apparatus when it comes into the proper position for exhibiting the required letters numeral device or the like

SUPPORT AND GUARD FOR TELEPHONE WIRES —G W WELCH Decorah Iowa In the present patent the invention relates to means for the support and protection of telephone wires crossing under high voltage electric transmission lines the purpose being to prevent the broken high voltage wires from making contact with the telephone wires

Of Interest to Farmers

PEA THRESHER AND HARVESTER —G F PRITCHARD Elizabeth City, N C This thresher and harvester is of the type of machine an example of which forms the subject of United States Letters Patent, No. 1 117 904 formerly granted to Mr Pritchard The prime object of the present invention is to improve threshers of the indicated character, particularly with reference to the simplicity and efficiency of the beating or threshing means and the actuating means therefor

SILO BLOCK —L MCNUTT, 28 S Walnut St Brazil Ind This improvement provides a construction of block of plastic material capable of hardening and a method of reinforcing the individual blocks and locking them together in superposed courses to form a circular wall capable of resisting any reasonable expansion stress

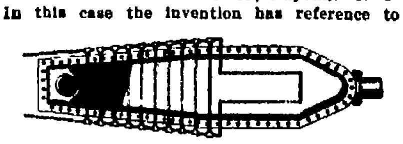
GRAIN SHEAF SHOCKER.—J P HIEBERT, Route 1, Box 100, Hillsboro, Kan The device may be attached to a grain mowing and binding machine so as to travel therewith and to receive the sheaves of bound grain as they are discharged by the binder Carriers carry the sheaves of grain rearwardly and deposit them closely together thus forming the shock The carriers are operated from the driving mechanism of the mowing and binding machine

Of General Interest

SELF LEVELING BERTH —R H HARMAN Box 194, Chester, Vt This invention relates generally to berths for use on ship board and more particularly to a self leveling berth the object being to provide a berth having a relatively short swinging movement as compared to that of the adjacent tilting or swinging parts and having in addition thereto a lateral ly tilting movement by which it is maintained in a level position at all times.

TOOTH BRUSH HOLDER —G LUNDY, 100 S Warren St, Madison Wis This invention provides a tooth brush holder having walls and a cover which extends beyond the walls but does not contact therewith at all points so that there may be a circulation of air within the holder to dry the tooth brushes which are inserted at the open bottom of the holder, and are supported on a rack within the holder

FILTERING PRESS —G BROWN 84 W 33rd St R 44 Y M C A, Bayonne N J In this case the invention has reference to

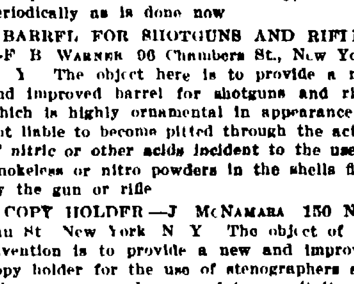


FILTERING PRESS

filtering presses and relates more particularly to a press whereby wax can be separated from mineral oils The object of the invention is the provision of a simple strong inexpensive, and efficient filtering press whereby wax can be separated from oil continuously, and not periodically as is done now

BARREL FOR SHOTGUNS AND RIFLES —F B WARNER 96 Chambers St., New York N Y The object here is to provide a new and improved barrel for shotguns and rifles which is highly ornamental in appearance is not liable to become pitted through the action of nitric or other acids incident to the use of smokeless or nitro powders in the shells fired by the gun or rifle

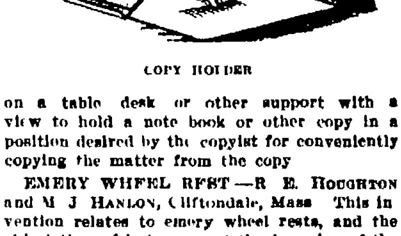
COPY HOLDER —J MCNAMARA 150 Nassau St New York N Y The object of the invention is to provide a new and improved copy holder for the use of stenographers and other persons, and arranged to permit its use



COPY HOLDER

on a table desk or other support with a view to hold a note book or other copy in a position desired by the copyist for conveniently copying the matter from the copy

EMERY WHEEL REST —R E. HOUGHTON and M J HANLON, Cliftondale, Mass This invention relates to emery wheel rests, and the object thereof is to prevent the jamming of the tool between the rest and the wheel, which

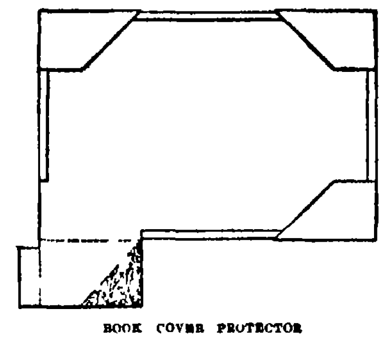


EMERY WHEEL REST

causes the breakage of the emery wheel and frequent injury to the workmen It provides a simple convenient, strong and easily adjustable rest for emery wheels and whereby work ing on the wheel is rendered safe

CIGARETTE CASE.—A A. MITCHELL, care of Woods & Chattellier, Inc 315 5th Ave, New York N Y This invention provides supports for individual cigarettes, for holding the same in spaced relation to the sides of a folding case, provides supports to prevent rotation of the cigarettes; provides a mounting for said supports, and provides means for spreading the sides of the case and for maintaining the medium relation of said support thereto for all degrees of spread thereof

BOOK COVER PROTECTOR.—G FORTUNE, Cincinnati, Ohio This invention relates to book protectors for the backs and covers of books, and one of the principle objects of the



BOOK COVER PROTECTOR

invention is to provide a simple protector of fabric or tape of strong paper and in different sizes, said protector having pockets at the corners for receiving the corners of the cover of the book thus providing a protector which is easily connected to the book and which will extend entirely over the back and cover of the book.

SAFETY BOTTLE —C H RUEGGER, 128 Henry St Hasbrouck Heights N J This improvement provides a structure which will always indicate to the purchaser whether or not the original contents is in the bottle It provides a bottle with a neck and breakable top portion and a filling aperture at the bottom

LEAF FOR SAMPLE BOOKS —C GREEN 78 Walker St., New York, N Y Mr Green's invention relates to devices for displaying samples and more particularly to a sample book of the loose leaf type and it produces a flexible leaf so constructed that the samples may be mounted upon one or both members thereof as desired

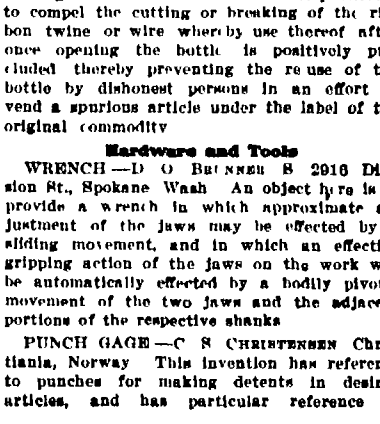
PICTURE FILM PERFORATOR.—H A WISEMAN 311 Sackett St, Brooklyn New York N Y Among the objects of this invention is the provision of a combined moving picture camera and punching device said punching device serving not only to perforate the film, but to actuate the film in step by step movement with respect to the camera lens

BOTTLE STOPPER RETAINER.—H V CLAUSEN, 29 Broadway New York N Y The main purpose here is to provide means for holding the seals in such manner as positively to compel the cutting or breaking of the ribbon twine or wire whereby use thereof after once opening the bottle is positively precluded thereby preventing the re use of the bottle by dishonest persons in an effort to vend a spurious article under the label of the original commodity

Hardware and Tools

WRENCH —D O BRUNNER S 2916 Division St., Spokane Wash An object here is to provide a wrench in which approximate adjustment of the jaws may be effected by a sliding movement, and in which an effective gripping action of the jaws on the work will be automatically effected by a bodily pivotal movement of the two jaws and the adjacent portions of the respective shanks

PUNCH GAGE —C S CHRISTENSEN Christiania, Norway This invention has reference to punches for making detents in desired articles, and has particular reference to



PUNCH GAGE

providing a punch for forming the drill centering holes in metal being formed into a die, and the main object thereof is to provide a gage for the punch which will insure uniformity in the distances of the centering holes from a given line and from each other

LATCH LOCK —K PRAZMO 346 E 9th St New York, N Y This invention relates particularly to locks of that type in which the bolt is capable of being thrown from the normal latch position to locking position, or vice versa by a key It provides a novel form of stop catch for the bolt, whereby the same can be locked against movement in either normal or unlatched position.

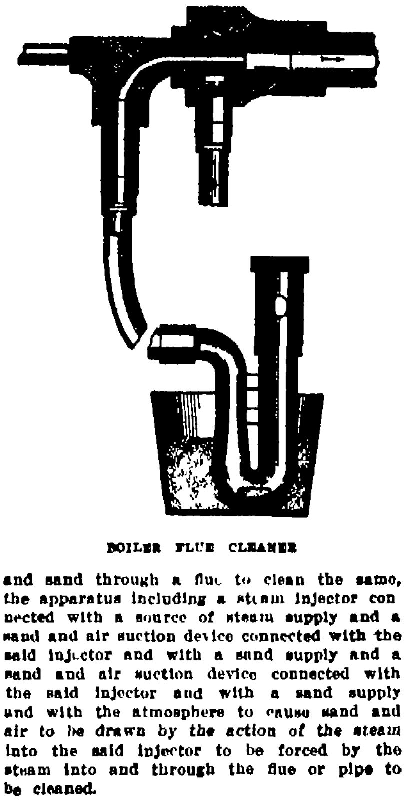
Heating and Lighting

GENERATOR. — L E HOWARD, Yamhill, Ore. This invention provides a generator for generating acetylene gas from a mixture of calcium carbid and water, wherein a generator is provided comprising a container for holding water, and having means above the water for feeding carbid to the water in the container and wherein a gasometer is arranged adjacent to the container to which the generator delivers, and wherein the feeding of the carbid to the generator is controlled directly by the movable part of the gasometer.

GAS HEATER FOR FURNACES.—F KORN, care of W Korn, 120 Center St, New York, N Y. This improvement provides a heater adapted to heat the water in a jacket surrounding the fire space of a boiler, provides a heater and means for controlling the same to maintain at relatively small gas expenditure the initial heat produced by the heater provides means for more fully graduating the heat maintained in the fire space of a boiler; and provides ring heaters having means for introducing the fuel at opposite ends thereof

ODORLESS CREMATORY —A. C. FELTON, JR., address Nye Odorless Crematory Co., Georgia Casualty Bldg, Macon, Ga An object of the invention is to provide an efficient device this efficiency being obtained by utilizing the heat of certain gases which would otherwise pass up the flue or chimney, by conducting these hot gases underneath the night soil pan of the crematory, before the products of combustion are permitted to escape.

BOILER FLUE CLEANER —A R. UHRIG and F P UHRIG, 7808 Quincy Ave Cleveland, Ohio In this invention use is made of an apparatus for forcing a mixture of steam, air



BOILER FLUE CLEANER

and sand through a flue to clean the same, the apparatus including a steam injector connected with a source of steam supply and a sand and air suction device connected with the said injector and with a sand supply and a sand and air suction device connected with the said injector and with a sand supply and with the atmosphere to cause sand and air to be drawn by the action of the steam into the said injector to be forced by the steam into and through the flue or pipe to be cleaned.

FIRE POT FOR STOVES AND FURNACES —A OHNEMUS, care of Excelsior Stove Mfg Co Quincy Ill. The invention relates more particularly to a fire pot the object being to provide a fire pot in the use of which the hydrocarbons escaping from fresh fuel will be better consumed within a stove or furnace and the waste of heat units, so often amounting to a considerable percentage of the total heat efficiency of the fuels, may be reduced to a minimum

RADIATING FIRE BOX FOR FIRE PLACES —A A JANNEY, 728 South Perry St, Montgomery Ala. This improvement has reference to open fire places for dwellings and other buildings, and more particularly to a box so constructed as to provide a heater for feeding a constant supply of heated fresh air to a room and also utilizing a large percentage of heat which would be ordinarily wasted

Household Utilities

FLY SWATTER —A R LAUBENSTEIN, Ashland Pa This improvement provides a fly swatter arranged to permit the handle and the swatting member to readily assume angular positions one relatively to the other to cause the swatting member to lie flat on the surface on which a fly or other insect is swatted, thus preventing the escape of the fly or insect.

PIE CRUST CRIMPER —M R. BECKETT and W J RITTER, address the latter, Wilcox, Pa This invention provides a pie crust crimper by means of which the crust of a pie may be readily and permanently crimped, and marked to indicated points at which cuts should be made for dividing the pie into equal parts, means being provided on the crimper for accommodating any bulging which might occur in the upper crest as a result of overfilling the pie

FLUSHING DEVICE.—N J GONDOLF, 708 State St., New Orleans, La The improvement resides principally in a retaining means to engage the float-carrying structure and retain the float in depressed position, to prevent the float from rebounding, without the employment of adventitious locking means, the continued lowering of the float due to the emptying of the tank, serving to release the float from the retainer, leaving the float free to rise as the tank again fills.

MILK BOTTLE HOLDER.—E. T. UNDERWOOD, 1855 Maryland Ave., N. E., Washing

(Continued on page 562)

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Classified Advertisements

How Guns Are Blown Up

(Concluded from page 554)

of the great war, without doubt, hundreds of rifles have been ruined by getting enough mud in the barrel to bulge or burst it.

In the case of the shotgun while practically every obstruction that occurs in the barrel enters from the muzzle and is the result of carelessness, yet there is the possible exception of a wad turned sideways in the loading of the shell, driven only part way up by the failure of the powder gas to exert full strength upon it and then sticking in the choke A quarter inch felt wad turned squarely across the tube at the choke offers enough resistance conceivably to check the shot and set up wave action of the gases at a very thin part of the tube

There is also the very possible and grave contingency of the accidental loading of a 20 bore shell into a 12 bore gun, in which event the smaller case slides down the tube until it fetches up at the choke Needless to say the resistance of a fully loaded 20-bore case, with its rim held at choke and refusing to go farther, is ample to blow up a barrel, and even though the gun be cylinder bored, the weight of the obstacle is ample to blow up the barrel The danger is particularly great in the case of the man who owns both 20 and 12 bore guns and carries shells for both in the same hunting coat It is so great that despite years of familiarity with firearms and with this very accident, I have twice dropped a 20 bore shell into a 12 bore chamber and had it slide down the barrel out of sight Luckily, the error was detected immediately

In England the accident grew so common that attempts were made to have all 20 bore cases colored black by legal action, to guard the shooter against this error with its never failing results if a 12 bore case is then loaded under the impression that no shell had been put into the gun and the shot is fired

The overload route to destruction is less peopled There is in the shotgun situation the unhappy phase of two sorts of smokeless powder, one loaded bulk for bulk with the old black powder, giving the same ballistics, taking up the same room, and because of its bulkiness, obviating any possibility of overload without showing in the lack of room for wads and shot The other is "dense," close kindred to high power rifle powder, very powerful and taking up little room It is loaded by weight in special shells, and for the 12 bore gun 24 to 26 grains is the standard So little room does it take that a double load can be put into a case adapted to bulk powder and the difference not show at all If some tyro gets hold of a can of this powder and goes to loading it through a bulk powder measure as he has been loading bulk smokeless, he gets an overload of more than twice as much of this dense stuff as can be safely shot in the gun and the result is hard on the gun and possibly on fingers, because then the blowup occurs well back on the barrel

While it is perfectly possible to blow up a gun through straight excess of pressure produced by smokeless powder burning naturally and doing its work normally, yet most blowups from overloads come from abnormal action of the powder Smokeless possesses the peculiarity that if subjected to more resistance than that for which it is calculated and so burning under far higher pressures than normal, it may cease to burn at a rate comparatively slow, with its gradual evolution of gas, and instead detonate

Detonation means the instant ignition or breakdown of the powder into its gaseous elements by a wave through it somewhat akin to vibration or the transmitting of sound through a solid substance, like an iron pipe Instead of burning normally and progressively, the entire charge is instantly resolved to its greatest possible volume of gaseous elements with tremendous pressure, and naturally the rending of the containing walls

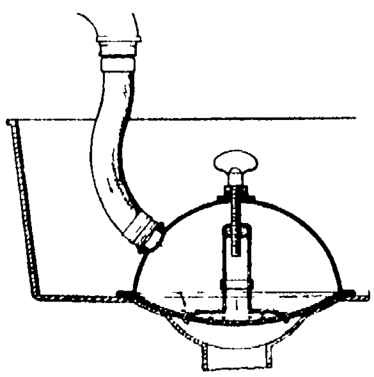
(Continued on page 563)

(Concluded from page 560)

ton D C The invention has for its main or principal object the provision of a device of simple construction, and one which is easy to apply to the doorway of a house and which can be cheaply made and sold. The device is sanitary and out of the reach of prowling marauders, such as cats, dogs and the like.

CONVERTIBLE BED —L B JEFFCOTT 250 W 15th St New York N Y This invention provides a convertible bed arranged to permit of conveniently extending the parts lengthwise to form a bed or to fold the parts to take up little room and to allow of using the bed when in folded position as a davenport or a divan at the same time making provision for convenient storing of the bedclothes or other articles

DRAIN AND WASTE PIPE CLEANER —W J CROCKER and DE LANCE WALLACE P O Box 1574 Spokane Wash This invention provides a means whereby waste and drain



DRAIN AND WASTE PIPE CLEANER

pipes leading from sinks wash basins bath tubs and so forth may be readily cleaned by the removal of obstructions therein and in a short time and without any special amount of exertion and without the requirement of special tools and of skilled labor It affords means whereby a direct water passage from a faucet or other water supply under pressure may be established to the waste pipe or drain pipe, whereby water may be forcibly flushed through the latter so as to carry away any obstruction

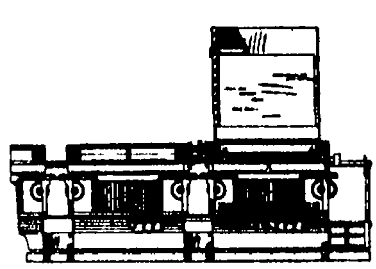
Machines and Mechanical Devices

BALL BEARING —E OLDFIELD 585 Main St, Norwich Conn This improvement consists of washer like separators interposed between the balls each of said separators being hung centrally and loosely on the pins or rivets that connect the said rings or plates in such manner that each separator is free to adjust itself to the varying positions assumed by the balls on either side of said separator

LOLLYPOP MACHINE —H W ERNY 75 Fulton St New York N Y The invention provides a machine for manufacturing lolly pops the machine comprising means for molding the lumps rapidly from a mass of material and at the same time each lump is being formed a stick is forced into it the operation continuing rapidly at a constant uniform speed and producing a uniform product

CUTTING ROLL.—R BURTON 26 Carmen St New Brunswick N J The inventor provides a cutting roll in which the steel cutting knives are set or driven into the peripheral face of a wooden core the core having metal foundations for the back of the knives to rest on so that the knives are held against inward movement, thus maintaining the cutting edges of the knives in true circular shape

DUPLICATING DEVICE FOR TYPE WRITING MACHINES —H W MORLEY, Angola Ind An object of this invention is to pro-



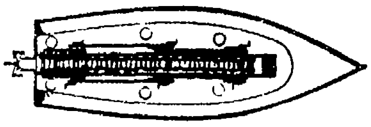
DUPLICATING DEVICE FOR TYPE WRITING MACHINES

vide a device for duplicating the work done on a type writing machine which dispenses with the necessity of using carbon copies thereby eliminating the time necessary in inserting and taking out carbon paper eliminating the cost of the carbon paper and doing away with the possibility of soiling the hands of the operator by the handling of the carbon paper

MITERING MACHINE — G M REPP, care S L Parsons 45 Rose St New York N Y Among the objects of this invention is to provide a machine with delicately adjusted gaging devices for the manipulation of a plurality of blanks such as rules or slugs of metal and sawing or mitering the ends of all of them at the same time and in a precisely uniform manner

WINDING DRUM FOR GLASS-DRAWING APPARATUS —S B HENSHAW care of Charleston Window Glass Co Charleston, W Va This invention pertains more particularly to a winding drum forming part of the hoisting mechanism the cable of which is connected to the vertically moving cage operating above the well or drawing chamber of the glass furnace and upon which the bait is seated to draw a cylinder of glass from the well just mentioned

PROPELLING MECHANISM FOR BOATS —J H MOON 406 E. 11th St., Portland, Ore This invention relates to an improvement in boats and more particularly to an improvement in the propelling mechanism of a vessel It provides an endless propeller in the form generally of a chain having blades movable into different positions for acquiring the most advantageous results when moving through the water said blades being adapted to auto-



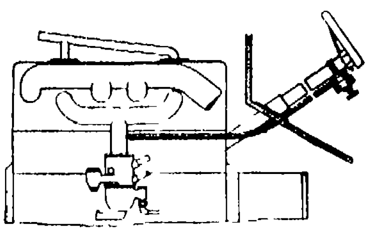
PROPELLING MECHANISM FOR BOATS

matically assume the proper positions whether the chain be drawn in forward or in reverse position It provides a propelling mechanism including an endless propeller chain and including means for manually transmitting power to the chain River boats equipped with the propeller can run in the summer season when the water is so low that the double keels will bobble on the bottom of the river without injury to the propeller and at the same time the propeller has full power to drive the boat The patent for this propeller is pending in the Canadian Patent Office

UNIVERSAL JOINT —E S ROBINSON, 5908 Bryant Ave Oakland, Cal This invention has particular reference to the manner of joining the sections of the housing thereof together It provides efficient means for joining the sections of the housing together whereby relative movement therebetween and resultant injury to the fastening bolts is prevented

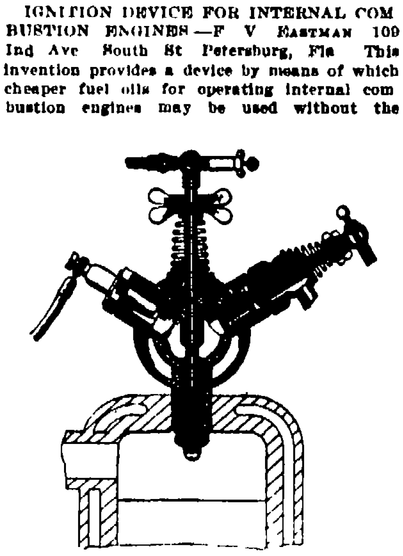
Prime Movers and Their Accessories

EXHILARATOR FOR COMBUSTION ENGINES —H P MERTEL and E. WENDLAND Address the latter 815 Syms St., West Hoboken, N J This invention provides means for admitting atmospheric air to the manifold of the engine and intermediate the explosion chambers and carbureter thereof, for increasing at will the air content of the fuel charge provides means for manually varying and controlling the proportion of air included in the charge provides means for controlling the proportion in the manner mentioned in position convenient for the operator and provides means for dissipating the effect of a back fire of the engine



EXHILARATOR FOR COMBUSTION ENGINES

IGNITION DEVICE FOR INTERNAL COMBUSTION ENGINES —F V EASTMAN 109 Ind Ave South St Petersburg, Fla This invention provides a device by means of which cheaper fuel oils for operating internal combustion engines may be used without the



IGNITION DEVICE FOR INTERNAL COMBUSTION ENGINES

usual ignition troubles heretofore arising from the use of such fuels. It prevents the deposit of carbon which ordinarily occurs in internal combustion engines of the common type and provides means for preventing the disastrous effects of moisture upon the ignition system

MIXING VALVE —G S VAUGHN Franklin Pa The invention pertains to mixing valves for explosion engines, and the object thereof is to provide a valve wherein the size of the opening through which the gas passes can be varied to suit the particular conditions under which the engine will have to operate

ENGINE —L. H R. ROGER, Bernheimer, Mo. This invention is of particular value in connection with power engines using steam, gas, air or other elastic medium. It comprises an engine cylinder built up in sections, each adapted to be inflated and deflated so that the cylinder as a whole expands and contracts and thus applies power to a crank shaft or the like

Railways and Their Accessories

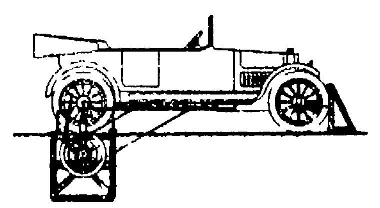
POWER REGULATING DEVICE FOR BRAKES —C C LAYMOND, 518 Miami St., Marion, Ohio. The present invention has reference to braking connections for railway and other vehicles, and more particularly to a construction for automatically increasing and decreasing the amount of power applied to the brakes themselves in conformity with the load in the car

TRAFFIC CONTROL SEMAPHORE.—A. A ANDERSON 80 W 40th St., New York N Y This improvement provides a traffic signaling apparatus, which may be seen at a distance provides the apparatus with movable members adapted for arrangement in correspondence with the movements understood as signifying certain intentions on the part of the operator thereof provides a semaphore with a plurality of arms provided each with indicating means visible at night and provides an apparatus with means for transmitting visible signals to a distant station

RAIL JOINT —R T BAGBY, Mascot Tenn The inventor utilizes the roller principle of load transmission whereby the track is made continuous for shear and bending without destroying free movement of the ends of the rails with variations in temperature thereby eliminating low joints and high centers particularly eliminating 'joint hammer' or the noise heard when wheels are crossing joints reducing cost of track and rolling stock maintenance producing an easier riding track and avoiding the possibility of nuts working loose

Pertaining to Vehicles

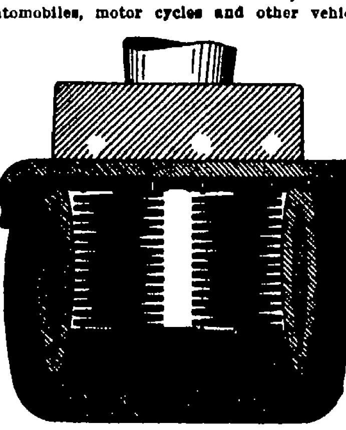
POWER TRANSMISSION —J S WALLACE, Burlington N D The invention pertains more particularly to a mechanism whereby power can be derived from an ordinary automobile for various purposes as threshing grain sawing wood hoisting pumping generating electric current, and the like especially on farms. The



POWER TRANSMISSION

invention improves and simplifies the construction and operation of machines of the character referred to so as to be reliable and efficient in use and so designed that an automobile can be easily and quickly brought into operative relation with the apparatus

RESILIENT TIRE —S SUSS, 117 E 89th St. and A Kaufman, 1596 2nd Ave, New York N Y Among the objects of the invention is to provide a tire to take the place of the usual troublesome tire so commonly used on automobiles, motor cycles and other vehicles



RESILIENT TIRE

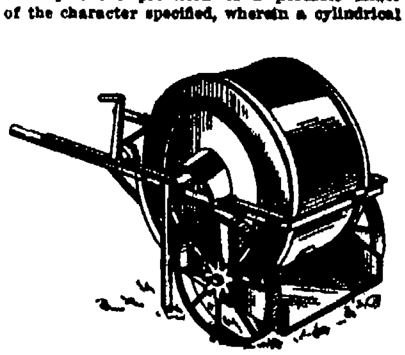
An object is to provide a tire of a unitary and complete construction adapted to be applied to or removed bodily from a wheeled rim of any standard or suitable nature, the new tire being provided with radially disposed coil springs of peculiar construction and connected to one another and to a rim portion of the tire by novel means.

RESILIENT WHEEL.—P PIERI Buckingham Hotel 5th Ave., New York, N Y The invention has particular reference to the construction of wheels intended especially for automobiles or other vehicles for the conveyance of passengers or other loads. An object is to construct a vehicle wheel of peculiar form and possessed of special resiliency or ease of action under various loads or inequalities of roadway

TIRE PUMP —H. F MOLKENBUR, 887 Forest St St Paul, Minn. This invention refers to air pumps, and provides a pump adapted for connection with pneumatic vehicle tires which will automatically maintain the air within the tire at a desired pressure by taking advantage of the variations from mean pressure while a vehicle is being driven over the usual road inequalities.

SLACK ADJUSTER FOR BRAKES.—A. WOODS, Box 221, Vernon, B. C., Canada. In this invention the brake rod and the slack adjusting means have a non-turning, reciprocating movement in one direction in response to a movement of the brake-applying means, and upon an abnormal return stroke due to slack, the slack adjusting means will be given a turning movement during a portion of said return stroke whereby to vary the total effective length of the brake rod to regulate the slack.

COMBINED DUMP CART AND MIXER.—L. L. CARTER, 196 22nd St., Portland, Ore. Mr Carter's invention is an improvement in concrete mixtures, and the invention has for its object the provision of a portable mixer of the character specified, wherein a cylindrical

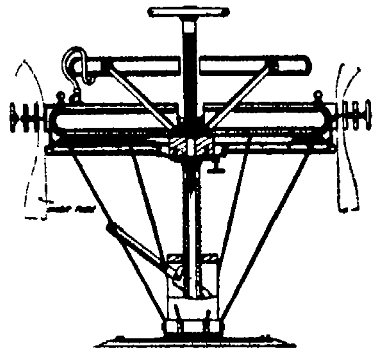


COMBINED DUMP CART AND MIXER

container is provided, having mixing vanes or blades and mounted to rotate on a wheeled support, and having means for rotating the same, the support having a delivery chute to which the container delivers.

AUTOMOBILE WHEEL.—F M. CROSS, Hundred W Va The invention relates to an improvement in automobile or other vehicle wheels, and more particularly to that type in which the resiliency is imparted to the wheel at the hub or center thereof It provides a wheel having a stationary hub around which the wheel rim travels the hub being provided with means for imparting resiliency to the wheel

VULCANIZER.—J B STROUD, Pass Christian, Miss The invention provides a vulcanizer especially for use with automobile tires, wherein the vulcanizer is so arranged



VULCANIZER FOR AUTOMOBILE TIRES

that the shoe or casing of the complete tire may be easily inserted for vulcanizing and removed, and wherein a number of inner tubes may be simultaneously vulcanized during the vulcanization of the tire It so supports a portion of the vulcanizer that it may be adjusted at a convenient height for working on the tire and to permit the vulcanizer to be adjusted for various sizes of tires.

Designs

DESIGN FOR A FOLDER FOR GLASS PERCOLATORS.—R KOHN, 48 E. 19th St New York, N Y In this invention the design shows a post seated on a base At the bottom of the former a thin arm holds a lamp and at the top of the post a heavy arm extends in one end of which is a ring shaped holder of the glass percolator The design is exceedingly simple and graceful

DESIGN FOR A RUBBER PAD FOR BOOTS AND SHOES.—H P FOUQUE, 218 Flushing Ave., Brooklyn, N Y., N Y In this case the ornamental design for a rubber pad for boots and shoes, is shown in a side elevation and in an inverted plan view thereof.

DESIGN FOR A GAS HEATER.—G F RESNOR, care of Resnor Mfg Co, Mercer, Pa. The design is characterized by a body having a transversely rounded top and a vertically rounding member ranging longitudinally across the front of the body at the bottom of the said top, said member projecting beyond the surface of the top, and the said body presenting a broad open front below the said longitudinally ranging member Mr Resnor has invented another design for a gas heater which is characterized by a front view presenting the simulation of a plurality of logs disposed as an incline, one above another, with rustic standards beneath the lowermost log, and rustic [illegible] ranging between the said standards.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

because of the lack of time to start the projectile in the gun.

Dynamite, lyddite, shimose, trinitrotolune and kindred high explosives are made to detonate by suitable violent explosives in small volume, such as the fulminates or azides, while against this process is the slow, controlled, work producing burning of the propellants used to drive the shot. It is under abnormal conditions, such as excessive pressures, that propellants cease to be propellants and turn high explosive This is probably what happens when dense shotgun powder is loaded in double loads into a shotgun, because very often such error will blow out the chamber walls at the thickest point and not move the charge of shot clear out of the barrel

Automatic pistols and revolvers have in the past been the children of trouble because of the use by cartridge makers of a finely cut leaf explosive, coming in little square leaflets as thin as tissue paper and having a great fondness for each other and for anything to which they may cling So powerful is this powder that it occupies but a very small part of the space in the revolver or pistol cartridge Three grains will drive the standard .32-caliber revolver bullet at more than the standard velocity Because of the "stickness" of this powder, it has the pleasant habit of occasionally failing to fall through the measure when being loaded into shells, and leaving one cartridge with no powder or only part of a charge, while the next one profits (?) by the loss of the first one The first one often drives the bullet only into the barrel, where the next shot will bulge the barrel of the automatic pistol, which is very thin, setting it up into the slide or casing and effectually putting the gun out of business.

Recent Improvements in the Transmission of Steam Through Underground Conduits

(Concluded from page 558)

duit to give clearance for pipe lines coupled with flanges instead of couplings In each rib is a pair of pockets some 8 inches apart, one pair registering with the other, to receive the fingers of the pipe support and thus lock them into the predetermined positions, thereby preventing the support from creeping out of place through chattering or other disturbance of the pipe in or out of service Creeping of the supports would alter the distribution of weight upon them and result, not unlikely, in the settling of the conduit, which would throw the pipe lines out of vertical alignment, the latter being an essential in realizing perfect drainage of the entrained water, preventing the accumulation of water in "dips," etc The space between the ribs and below the supports forms a drainage passage permitting leakage or seepage to be carried away to the drain outlet without effecting the efficiency of the heating pipes.

The supports are perhaps the more interesting feature of the heat-conveying conduit. In the single pipe-line support the weight is distributed to the conduit through four points. The plural line supports, on the other hand, are anchored by bosses extending down into the rib-pockets and are supported by the cradle-plate bearing on the ribs the full length of the support at each side. The cradle portion of these supports—that which rests on the ribs or in the rib-pockets—has a depressed pocket with toothed racks and drainage holes. In this pocket is placed a toothed roller upon which rests the pipe-supporting saddle, having, on its under side, racks of teeth that mesh with the teeth on the roller "Keeper" flanges on the saddle extend down over the ends of the roller to prevent side deflection of the pipe line in either direction. In operation, the roller travels one tooth over the cradle racks and carries the saddle one tooth forward on the upper teeth. The saddle travel is, by this action, twice as fast as that of the roller on the rack in the cradle-pocket, and a roller clearance of [illegible] inches in the cradle-pocket therefore [illegible] the saddle and the pipe resting [illegible] inches—enough travel to take care of all the expansion ordinarily necessary in practical work. Extraordinary expansion travel demands the simple expedient of dividing the expansion element into two ranges. The teeth of the three elements of the support being in mesh, it is impossible for the roller to creep forward or backward through chattering of the pipe, or to skew forward or backward at either end This insures the roller setting keeping its place permanently

It is claimed by the manufacturer that a pipe installed as outlined herein can never sag out of alignment, that the pipe can be covered entirely at the supports, thus reducing the thermal loss to the utmost degree, and that the pipe is held high and dry so that seepage cannot affect the efficiency of the pipe in the slightest, nor the leakage permanently soak the insulating covering and so by its vapor destroy the efficiency of the heating line by condensing the steam within. The pipe and covering being high and dry and a drainage space being provided below it, under ground drainage, usually so essential to any other forms of conduit, is not necessary with this in any but swampy or very wet ground and generally then only as an extra precaution

How an Inventor Successfully Conducted an Infringement Suit

(Concluded from page 558)

necessary to give the bench a comprehensive and a convincing grasp of the subject matter Mr Perlman realizing that the judges were not engineers, asked himself how he could be made to understand the mechanical features if he were one of the court. The defense had cited no fewer than 150 patents and other alleged anticipatory disclosures and their intention was to present and to discuss each of these in order to disprove infringement and, incidentally, to invalidate the claims embodied in the Perlman patent Realizing that the court might be confused by the mass of evidence, the inventor and his attorneys cleverly prepared, after much study, two striking exhibits

One of these showed graphically on an enlarged scale the eleven fundamental classes of rims covering the prior art, and then by nine other drawings on a like scale they illustrated the evolution of the art of demountable rims so far as was akin to the patent involved Another bone of contention was the action of the wedges covered by the Perlman patent. It had been disputed that the adjustment of these sufficed to exert pressure in more than one direction The inventor claimed that in seating these threaded wedges or taper tip bolts he was able to accomplish a wedging effect radially and sidewise thus tightening the rim circumferentially on the wheel while securing it so that it would not slide off To demonstrate this dual action, the plaintiff devised a mechanism that showed upon two graduated scales, set at right angles that force exerted by an inclined plane, acting upon a point in space, to produce a desired pressure on one scale automatically attained the same measure of pressure upon the other scale The veriest layman was able to see the drift of that mechanically established argument.

Ordinarily, the plaintiff in an infringement suit merely describes the features claimed by the patent involved and explains their application or force Then the defense proceeds to cite the prior art and to parade its array of supposedly anticipatory patents In the Perlman suit there was a big battery of these, designed to hammer away at the plaintiff's case, but that formidable aggregation was largely spiked at the start by the course pursued in the opening address of plaintiff's counsel The court was quickly familiarized with the prior art by reference to the first eleven diagrams, and the nine other drawings alone covered the essence of the matter in suit When the defense took up the case, the court promptly classed each patent as it was cited under one or the other of the eleven heads, and, as a result, only twelve out of the total number of patents were really the subject of argument. In short, the

plaintiff's counsel educated the court at the very start, and thus prevented confusion and saved time.

There are probably 3,000,000 automobiles in service to-day in this country; and it is estimated that the factories will turn out 1,200,000 cars for the season here of 1917 Approximately, 60 per cent of existing cars and 80 per cent of those building for the American trade are designed to carry demountable rims A set consists of five tire rims, four felly bands, and associate parts, and the present market value per set is in the neighborhood of $15 This contribution to motoring comfort will, therefore, represent an annual business to the rim makers of anywhere from $20,000,000 to $25,000,000, allowing for repairs and replacements. No wonder the inventor has fought for his patent and defended his title since it issued a little over three years ago

A Machine That Picks Cotton Without Injuring the Plant

(Concluded from page 551)

of the machine and returned to the center passageway, ready to pluck the cotton bolls from a fresh plant The design of the picker points makes it impossible for them to be twisted together, hence the most vulnerable member of most cotton picking machines is in this case perhaps the strongest

The cotton picking machine described has been developed and perfected during the past few years Aside from the features already mentioned it claims light weight—about 1,000 pounds

War Game—XI

(Concluded from page 557)

The stricken transport reached shallow water just in time to be saved from sinking The troops immediately began to land on Thompson's Island

The Blue torpedo boats firing at the landing Red troops retired toward the river The "Sphinx" was put out of action by a shell from the Red cruiser, and limped into Hatfield harbor

At 5 P M, under cover of a heavy fire from all the enemy war craft, the two transports steamed into the bay and dropped anchor behind Murphy Point breakwater and immediately began to land, with the help of boats and lighters At 6 P M two battalions of infantry, with machine guns were established across the small peninsula

Questions

Question 1 The action of the Blue detachment under General G was purposely left out of the above Supposing that General G was, at 2 40 P M, at the Sherwood Field Club Building, observing the naval situation, what disposition would he make?

Question 2 There is another Blue coast battery hidden somewhere around the bay Why did this battery of 3-inch rapid fire guns remain silent?

Question 3 Assume that the position of this Blue coast battery is behind the small hill south of the railway bridge when the transports put in to land troops what will the commander do, and will he open fire? Consider the Red battle cruiser, with its 12 inch guns is at 3,500 yards range

Question 4 Locate the position of the Blue forces at 5 P M

Question 5 At what hour will the field batteries of the Blue forces open fire, and what will be their target?

Question 6 At 6 10 an explosion, caused by a torpedo sent from the Blue submarine sinks the battle cruiser of the Reds What will happen?

Answers to Questions in War Game X

Question 1 When Captain B, with his company in the firing line, has approached to within 200 yards of the cemetery, which is defended by a platoon of Red infantry, he has decided to make the assault. First of all, he looks to see if all of his men have their bayonets fixed He will then signal to his supports, upon whose aid he counts to carry through the assault. These men come forward on the run. As they arrive the signal for "cease firing" is given. Then, leading his men, Captain B. orders: "Follow me," and the enemy position is rushed.

Question 2 The enemy, driven from his position in the cemetery, can best be pursued by fire. Therefore a command to this effect will be given.

Question 3 Seeing the heavy reserves moving to assault the trenches, General G realizes that the enemy will attempt to pierce his lines near the small woods south of the railway bridge He immediately decides to open fire with his three guns, which have not yet been utilized by the Reds nor discovered by the Blues. Since the artillery observing station is also in the tower with him, he will simply give his order to the artillery officer The latter will immediately send word by telephone to the commander of the guns, giving him the target, the range and the deflection.

Question 4 Considering that the Blue forces intend to penetrate the Red line near the small woods south of the railway bridge, the best place for the machine guns would be either to the right or to the left of the point where the assault is expected to be made By a flanking fire the defenders of the trenches to be assaulted can be held down to the last moment.

Question 5 "Goat Hill,
"14 June 19—, 9 00 P.M
"We will hold the present position.
"Entrenchments will be constructed and position prepared along the Norrisville-Pottstown Railway
"The commanding officer of the left flank company will send a squad of volunteers to blow up the dam built by the enemy at the bridge over Conestoga Creek
"Cavalry remains as detachment reserve at the edge of Paoly Forest.
"I will be with the reserve"

War Game XII will deal with the strategical planning of a campaign and the working out of its tactical details.

A Significant Automobile Record

(Concluded from page 552)

by the way, was made last year by the same driver, E G Baker, was 11 days, 7 hours, 15 minutes, and the best record claimed to have been made by a relay team of four or five drivers is 10 days, 15 hours

The route from Los Angeles was through Flagstaff, Ariz, Albuquerque, N M., Trinidad, Colo, Dodge City and Emporia Kan, Kansas City, Mo, St Louis, and thence to Indianapolis, Ind, through Columbus Ohio, and via Wheeling to Pittsburgh and then to Philadelphia, and through Trenton to Jersey City

The car used in this test was a regular standard model, fully equipped with top, wind screen and guards, and all the other fittings that are found on the car as it is delivered to the ordinary buyer The crew consisted of but two men, E G Baker, the driver, who held the wheel the entire distance, and W F Sturm, a newspaper man, who is in no sense a mechanician, but the lack of expert technical assistance was no handicap, for it is asserted that not even a spark plug was changed on the journey, and the only adjustment made was of the carburetor while in the mountains of Arizona to compensate for the excessive elevation. The only repair considered necessary was the replacement of a front axle which had been slightly bent by colliding with the parapet of a bridge, but this was only as a matter of precaution, as several hundred miles were covered with the bent axle before the change was made

Good weather was experienced most of the way, but through Missouri heavy mud was the rule, and in one case two hours were required to cover ten miles. In this region the engine was run continuously on intermediate gear for 84 miles, an excellent test for endurance and radiator efficiency.

As already stated, the average speed was about 450 miles a day. The best day's run was 567 miles, and the highest speed recorded was 46 miles an hour.

These figures indicate a remarkably regular and well sustained speed, rather than a series of excessively fast dashes where the going was easy The consumption of gasoline figures at about 9¼ miles per gallon, and the oil at about 350 miles to the gallon, which is excellent, considering that the car was driven to the limit every foot of the way, with no regard for economy

It is not intended to suggest that a four- or a six-cylinder car is not capable of a similar performance, but only to point out that this test effectually disposes of any doubts that may have existed as to the dependability of the multi-cylinder engines From every point of view the demonstration made on this occasion records a triumph of engineering and shows the perfection that can be attained by scientific designing, the selection of materials and accurate manufacturing processes As a feat of human endurance the journey is unparallelled

Death of Elmer L. Corthell

AFTER an illness of several years duration, Dr Elmer L Corthell of North Egremont, Mass, died at a local hospital on the afternoon of May 16th, having attained the age of 77 years Dr Corthell was president of the American Society of Civil Engineers, and one of the most noted civil engineers in this country He had been prominently identified with numerous engineering societies both here and abroad

The Civil War broke out while Dr Corthell was studying at Brown University, whereupon he enlisted in the First Regiment, Rhode Island Light Artillery and saw four years' service in the Virginia and North Carolina campaigns At the end of the war he resumed his studies at Brown University, graduating with the degree of A. B in 1867 One year later he received his A M

He then took up engineering work and served in the construction of several Middle West railroads In 1875 Dr Corthell took charge of important engineering work at the mouth of the Mississippi River Four years later he left for the Isthmus of Tehauntepec, Mexico where he conducted surveys on both the Atlantic and Pacific Coasts for the proposed ship railway Shortly after he built the New York, West Shore & Buffalo and the New York Ontario & Western Railways into New York During 1885-87 he spent all his time working on the ship railway project, following which he entered into partnership with George S Morrison and supervised many large harbor works, bridges and viaducts Some time later he undertook the construction of the jetties of the Mexican Central Railroad at the mouth of the Panuco River in Tampico, and then, in 1891, went abroad to make a number of important investigations He spent much of his time gathering data for the establishment of the School of Engineering and Architecture at his university

During a period of eleven years he was engineer of the Boston, Cape Cod and New York Ship Canal which cuts across the Isthmus of Cape Cod In 1899 and for several years thereafter he served the Government of Argentine Republic in various engineering and representative capacities

Recent Paper Statistics

IN our issue of May 6th we published an article on the Paper Situation by Mr William Bond Wheelwright While the issue was on the press the Bureau of the Census issued a preliminary statement of the general results of the 1914 census of manufacturers for the production of paper and wood pulp The following statistics will be of interest as supplementing the article by Mr Wheelwright

In 1909 the production of wood pulp was 2,498,955 tons. In 1914 this had increased to 2,894,650 tons. This represents an increase of 15.8 per cent. In addition to the domestic production, 534,395 tons of pulp was imported, an increase of 77.3 per cent over 1909. Other materials used during 1914 comprised 371,346 tons of rags, 1,577,845 tons of waste paper, 121,

280 tons of rope, jute bagging, threads, etc., and 300,345 tons of straw These items represent a decrease in the importation of rags and rope, etc., and considerable increase in the importation of waste paper and straw.

The total value of the paper produced in 1914 was $294,355,875, an increase of 25 1 per cent over 1909 Of this the newspaper production amounted to 1,313,284 tons, representing an increase in quantity of 11.7 per cent and in value of 13 per cent. The production of book paper was 934,979 tons, representing an increase in quantity of 34.5 per cent and in value of 34.1 per cent. The production of fine paper, 247,728 tons, represents an increase in quantity of 25 per cent and in value of 17 1 per cent. Wrapping paper shows an increase of 15 per cent in quantity and 16 3 per cent in value, the production being 881,799 tons The output of wood pulp board, news board, binders' board and all other boards in 1914 aggregated 1,288,527 tons, representing an increase of 50 8 per cent in quantity and 55 9 per cent in value The production of all other kinds of paper amounted to 700,643 tons, an increase of 19 per cent in quantity of 21 1 per cent in value

LEGAL NOTES

Expensive Refunds —Under the present system, which Commissioner Ewing seeks to have corrected, all refunds of money paid the Patent Office by mistake must be certified to the Treasury Department. These are audited and thereafter Treasury warrants for the respective sums drawn. Out of 6,000 a year, three fourths of the warrants are for less than one dollar and hundreds of them are for five cents each The auditing and refunding are estimated to cost one dollar for each transaction, so that in hundreds of instances one dollar is the cost of refunding five cents

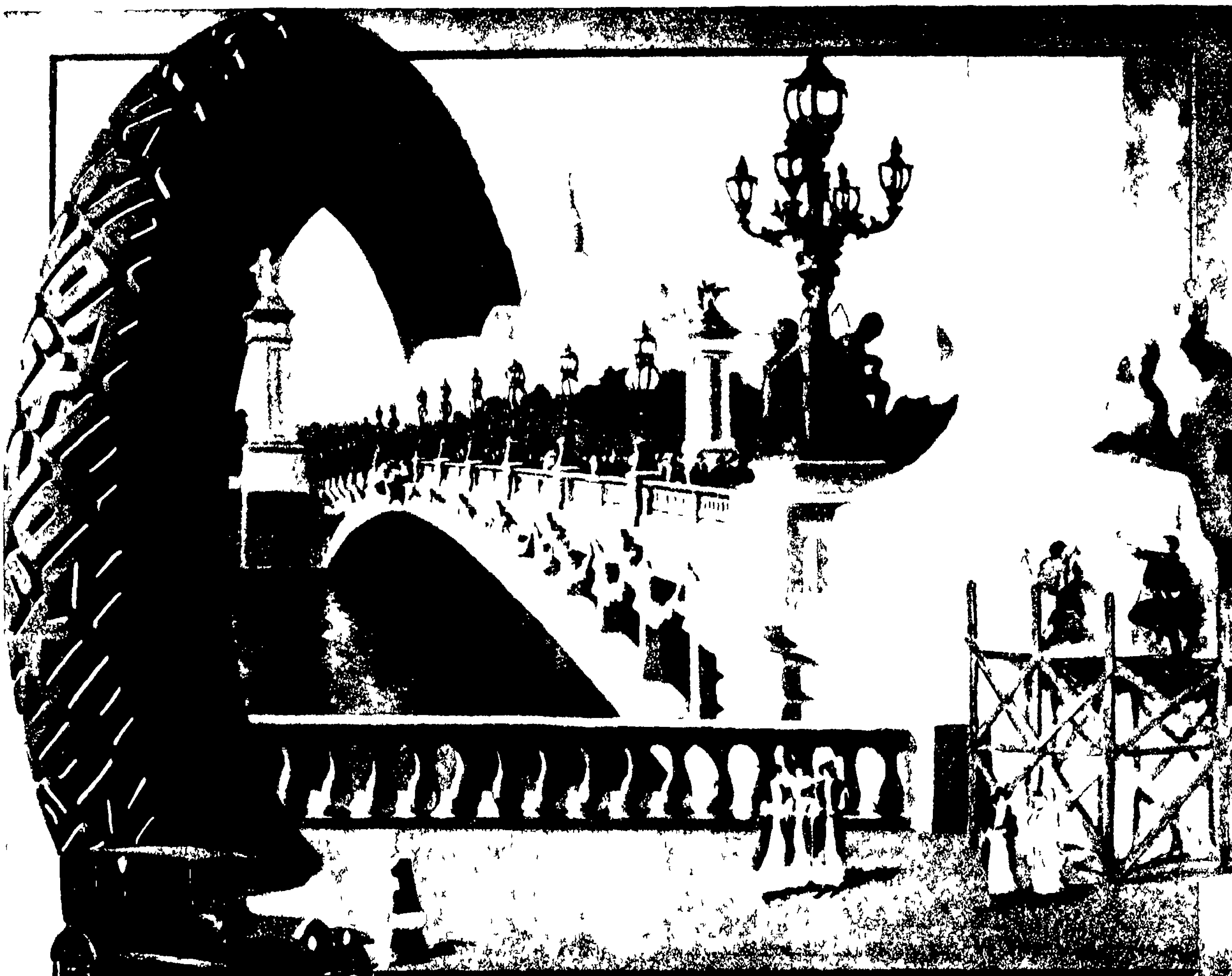
An Important Recommendation —Commissioner Ewing has suggested to Congress that the law be amended to require the clerks of the Federal courts to file in this office a copy of every decree granting or refusing an injunction in a suit for infringement of a patent and every final decree affecting the validity of a patent

If such copies were filed in the Patent Office and placed in the file of the patent it would enable any one to determine the litigation in which this patent had been involved, a thing which is now practically impossible since many of the decisions of the lower courts are not published.

Disregards Priority of Adoption of Trademark Under Circumstances. —The Supreme Court of the United States on writ of certiorari in cases involving certain flour milling companies held that where two parties independently are employing the same mark upon goods of the same class, but in separate markets wholly remote from one another, the question of priority of adoption of the mark is legally insignificant unless at least it appears that the second to adopt the mark has done so with some design inimical to the interests of the first user

The Farmer and the Mechanic —In addressing an agricultural fair, Bob Ingersoll told of the farmers' dependence on the mechanic and the inventor, saying.

"Many farmers seem to imagine that farmers are the only laborers in the world. This is a mistake. You can not get along without the mechanic You are not independent of the man of genius. Your prosperity depends upon the inventor The world advances by the assistance of all laborers, and all labor is under obligations to the inventions of genius. The inventor does as much for agriculture as he who tills the soil. Until genius and labor formed a partnership there was no such thing as prosperity among men. Every reaper and mower, every agricultural implement, has elevated the work of the farmer, and his vocation grows grander with every invention. In the olden time the agriculturist was ignorant; he knew nothing of machinery; he was the slave of superstition."



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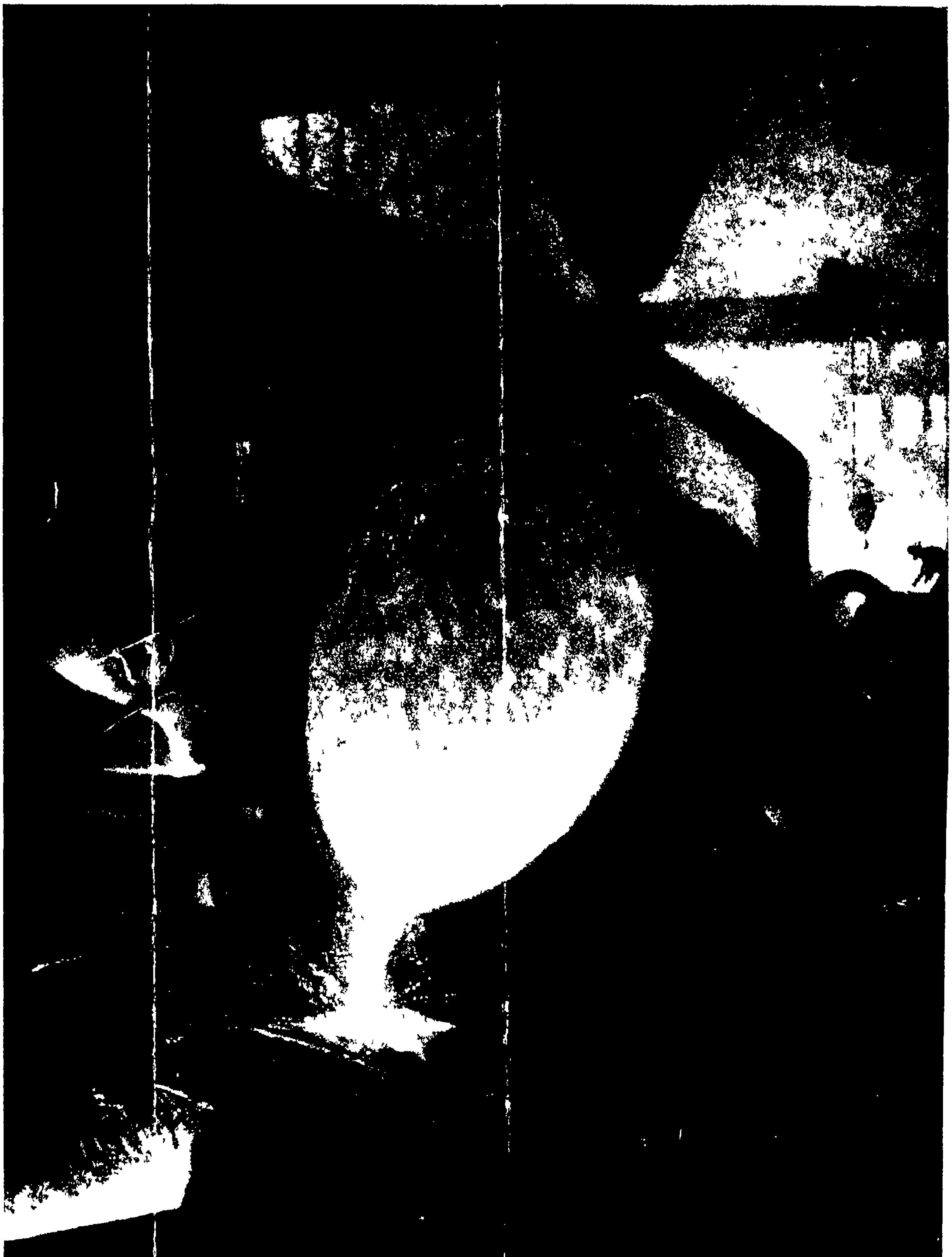

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SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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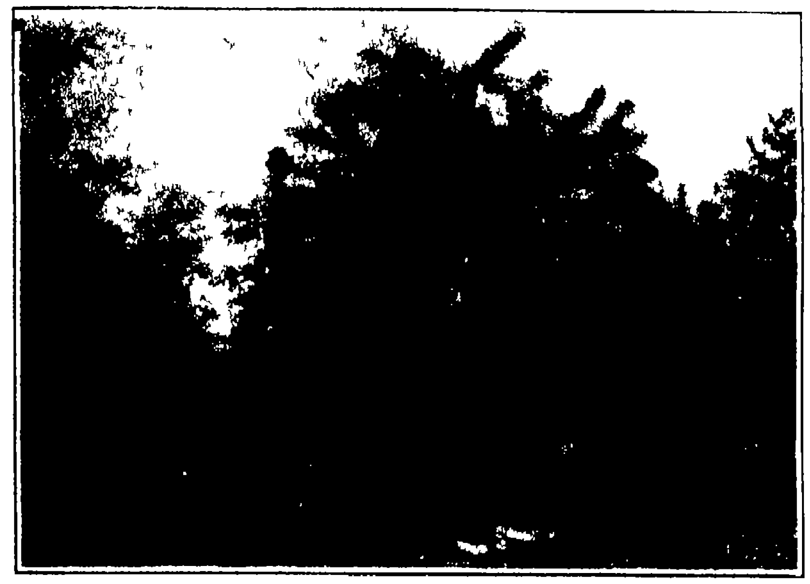
Cherry-picking time in a cherry-growing district



Cherry-pickers and the special ladders they use

Utilization of Cherry Waste Products*

By Frank Rabak

THE fruit packing industry of the United States has developed rapidly in recent years This rapid development has been accompanied by large accumulations of by products which have no apparent value, and hence are discarded as waste. These waste products may occur as either the exterior or the interior portion of the fruit, and in some instances even the fruit itself being unsuitable for packing becomes a waste material

Attention has recently been called to the large quantities of waste resulting in the extensive cherry packing industry of the North Atlantic, North Central and Western States. In the canning of cherries, large quantities of pits and juice result from the pitting process to which the fruit is subjected At the present time these by products are entirely wasted because of their lack of utilization

The extent of the cherry packing industry is indicated in the agricultural statistics of the States mentioned. According to the thirteenth census of the United States, the quantity of cherries grown in New York in 1909 was 271 507 bushels in Michigan 338,945 bushels, and in Wisconsin 81,440 bushels, making a total of 691,882 bushels, or 20,756 tons The amount grown at the present time is doubtless considerably in excess of these figures Approximately 80 per cent of the crop is canned, which is equivalent to 553,500 bushels, or 16,605 tons The total output of the California orchards in 1909 was 501,013 bushels, or about 15,000 tons

The two by products of the cherry industry, the pits and the juice, are at present entirely wasted From the standpoint of commercial utilization the pits, which constitute about 15 per cent of the cherries, are the largest and most important of these waste products

During the year 1914, it was estimated that 1,000 tons of pits were available as a by product. This tonnage of waste pits is, of course, dependent largely upon the crop of each season with an increasing tendency as the industry expands.

The cherry juice which results simultaneously with the pits accumulates to a somewhat less extent It is estimated that about 70 gallons of juice result from one ton of cherries. The approximate quantity of juice available annually as a waste product is about 112,000 gallons.

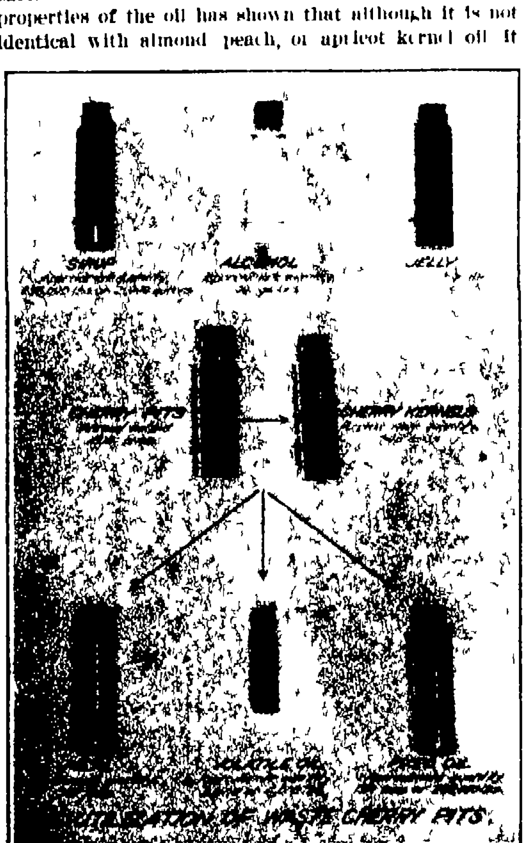
Much thought and consideration has been given by packers to the possible utilization of these waste products which if converted into marketable substances would give added stimulus to this important branch of the fruit industry.

It has been found by investigation that a fatty oil not greatly dissimilar to that of sweet almonds, peach, or apricot kernels, can be extracted from the waste pits. The oil is contained in the kernels which by the application of hydraulic pressure can be made to yield about 30 per cent of fatty oil Besides the fatty oil there can be produced a volatile oil which is for all practical purposes identical to the oil of bitter almonds The cherry kernel meal remaining possesses valuable stock feeding qualities

Cherry juice has been found capable of being converted into alcohol sirup or jelly

In outlining a process for the utilization of the pits the initial step consists in the separation of the kernels from the pits by cracking and subsequent screening The resulting kernels when reduced to a meal by grinding and subjected to hydraulic pressure can be made to yield the fatty oil previously mentioned The press cake remaining from this procedure when macerated with water and distilled with steam yields the volatile oil, the cherry kernel meal remaining as a residue

Cherry kernel oil possesses a pale golden yellow color, and a bland odor with a fatty, nutlike taste A careful examination of the physical and chemical properties of the oil has shown that although it is not identical with almond peach, or apricot kernel oil it



By-products that are obtainable from waste cherry pits

is not fundamentally different from any of these Since almond peach and apricot kernels yield oils of commercial value cherry kernel oil which stands in close relationship should likewise be commercially useful Almond oil is at present used chiefly in pharmaceutical preparations Peach and apricot kernel oils besides their use as edible oils are also therapeutically efficient

Cherry kernel oil should be adapted to all the purposes for which these oils are at present used

Considering 1 000 tons as a normal year's supply of pits which consist of 28 per cent kernels there would be available annually 448 tons of kernels From this quantity of kernels 134 tons or 268 000 pounds of fatty oil should be obtainable The value of the oil would depend entirely upon its particular use and demand The price of the closely related peach kernel oil ranged from 22 cents a pound in 191 to 15 cents in 1915

The volatile oil which does not pre exist in the kernels but is found by chemical reaction when the ground press cake is macerated in water is obtained to the extent of 0 95 per cent by distillation of the macerated mixture About one pound of volatile oil may be obtained from 100 pounds of press cake and is practically identical in both physical and chemical properties to the oil of bitter almonds peach or apricot kernels The volatile oil of cherry kernels is a pale straw colored liquid with pleasant characteristic bitter almondlike odor and a sweet and strongly pungent taste

Approximately 314 tons of press cake would be available annually for the production of the volatile oil Calculating on the basis of 0 95 per cent yield about 3 tons or 6 000 pounds of volatile oil would result The volatile oil from cherry kernels being closely identified with the bitter almond oil, which is used medicinally and in the manufacture of perfumery and confectionery should find similar application in commerce The wholesale price of bitter almond oil during the year 1915 was $6 per pound In January 1916, the oil was virtually unobtainable and was quoted at $9.25 to $11 per pound It seems reasonable therefore that the production of the volatile oil constitutes an important step in the conversion of the waste pits into a source of profit

The residue remaining after extraction of the volatile oil when dried and reduced to meal is suggested as a stock food A comparison of the meal with other standard feeding stuffs places it in a class with linseed and cottonseed meals both of which are recognized as valuable stock foods the current prices of which average about $30 per ton Roughly estimated the total available quantity of meal which would result annually after extraction of fatty oil and volatile oil would be about 300 tons

The waste cherry juice resulting from the pitting of the fruit is a bright red liquid with the characteristic odor and taste of cherries Experiments have

(Concluded on page 598)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Germany's Strategic Hold on American Industries

OURS is a wonderful country. Rich in all the natural products that man could desire. So rich that we have been prodigal in the use of materials placed at our disposal. Nevertheless we have been industrious and we have manufactured within our own boundaries most of the products we need. For only a very small part of the goods we require has it been necessary for us to look abroad. Our exports are greater than our imports. Before the war we were even sending to Germany a larger bill of chemicals than Germany was sending to us. It was natural for us to consider ourselves industrially independent. Certainly we were not gravely concerned by the fact that *some necessary products still came from abroad.*

When the war broke out, much to our astonishment, we found ourselves badly crippled for the lack of a few essential products. We realized then the strategic importance of Germany's coal tar industries, for by reason of the scarcity of dyes our great textile industries were paralyzed. Our very health was threatened for lack of important drugs which had always come from Germany. Even the food of the nation was affected by the sudden cessation of imports of potash.

It is not to be inferred that we are accusing Germany of having sought to destroy the industrial independence of this country by aiming at its clothing, its food and its health. The potash supplies of Germany are a natural resource. We have quantities of potash in this country, but as yet have not developed an economical method of obtaining it in practical form. As for the coal tar products, surely no country in the world is in a better position than this to supply all of its own needs and have a large surplus for exportation. Our production of pig iron is twice that of Germany, and consequently our production of coke must be correspondingly as great. But instead of saving the valuable by-products of coke manufacture we have been burning them up in the destructive beehive furnace.

In the past there has been little encouragement for us to save the coal tar, and it is for this reason that we suddenly find our industries dependent upon foreign products. The very consumers of these products have been unwilling to bear the cost of protecting the infant industries against foreign competition.

We ourselves are to blame for the dependent condition of our industries.

The House Shipping Bill

THE Shipping Bill of the year 1916 is the Shipping Bill of 1915 in a new dress. It is wrong in principle and amateurish in scope and construction; wrong in principle, because it places the Government in direct competition with private enterprise; amateurish in scope and construction, because from first to last it shows that its sponsors have not appreciated the magnitude of the problem, and have refused to be guided by the experience and wisdom of the practical shipping men of the country, who alone are versed in the intricate problems which are involved in the shipping business.

Briefly put, the bill creates a United States Shipping Board from which is to be excluded any one who "holds any official relation to any common carrier by water"—which shuts out at once practically all the men who have any experience or expert knowledge of the project.

The Board "may form . . . one or more corporations for the purchase, construction, lease, charter, maintenance and operation of merchant vessels in the commerce of the United States. The total capital stock thereof shall not exceed $50,000,000."

"The Board may, for and on behalf of the United States, subscribe to, purchase and vote not less than a majority of the capital stock of any such corporation."

Five years after the close of the war the corporation will be dissolved, the vessels will revert to the Board, and the Board may sell the ships and take over the stock not held by the United States at a fair value.

The Board is to exercise a supervision of all carriers by water engaged in the foreign and interstate commerce of the United States, broadly similar to that exercised by the Interstate Commerce Commission over the railroads.

Now we are unalterably opposed to this bill, because the entrance of the United States into the shipping business in competition with private interests would be at once a moral wrong and an economical blunder. Not only would it be an act of gross injustice to the citizens who have hopefully enlisted their capital in the effort to build up an American merchant marine, but, economically considered, the bill would inevitably defeat the very object at which it aims. With their own Government as a competitor, the shipping interests would fail to invest a dollar of capital to carry on a struggle which is already bristling with difficulty and discouragement.

But we object to the bill further upon the ground that the proposed Government Board, with its paltry $50,000,000, would be in a position to do no more than toy with this vast problem.

The National Foreign Trade Council has submitted to Congress a statement of its Merchant Marine Committee which shows that to increase within the next ten years the American foreign commerce carried in American ships from the present level of 14.3 per cent to 60 per cent would require between 6,000,000 and 10,000,000 tons of shipping, and the cost of the ships would be from $520,000,000 to $1,040,000,000.

In the presence of these authentic figures, compiled by the men who know, it will be seen why we have designated the shipping bill as amateurish. The House bill should be rejected as a pernicious makeshift—a mere playing with the problem.

And yet the necessary capital would be forthcoming if the present Administration would forego its foolish desire to embark in business, and settle down to the development of a broad, far-sighted shipping policy that would encourage the investment of private capital.

And the very first thing it should do is to repeal those iniquitous sections of the Seamen's Act which have already driven some of our most promising shipping enterprises off the seas.

The Dye Industry as a Factor of National Security

THE great European war has been a wonderful school teacher. It has taught us values never appreciated before. It has, above all, demonstrated our inconsistency. We have been so fearful of militarism that we dared not increase the size of our army lest it attack neighboring countries and involve us in destructive war, and yet we have been content to place entire confidence in the good intentions of powerful foreign countries armed to the very teeth. We have trusted them not to attack our rich treasure land.

Other lessons we have learned. We have discovered that mere numbers of men count for little; that it takes months to make a soldier of a raw recruit; that a fortress is valueless that without heavy artillery an army is as helpless as the man with a crossbow against a rifleman. We have learned that a modern battle pours forth costly shells like water. To keep the guns in action all the machine shops of a great nation must work night and day.

But probably the most startling lesson of the war is one that has only just begun to dawn upon us, namely, that there is a very close relation between the dye industry and preparedness for war.

There was a period, not many years since, when the dye industry in this country showed signs of healthy development. But at best the quantities of dyes used and the value of the industry compared to others of which it is a necessary adjunct, are so small that the public *is not apt to consider seriously the importance* of giving it adequate protection. The users of dyestuffs have been only too willing to let the industry languish, and thus it happened that Germany was permitted to undersell the American product and obtain complete control of the situation. Now that the war has thrown us upon our own resources, we have been endeavoring frantically to produce the needed dyes in this country. Raw materials are plentiful. There is no reason why we should not produce all the dyes we need in this country, only a very few are hedged about by patents. But what inducement is there for any company to engage in the production of dyes when, upon the declaration of peace, conditions will revert to the state immediately preceding the war, and there will be no adequate means of competing with foreign products?

Just here is where our latest lesson of the war comes in. We are beginning to realize the advantage to Germany of possessing a practical monopoly of the manufacture of dyestuffs. *A dye factory may be changed within a week or ten days into a factory for the production of high explosives.* The same materials are used and the same processes up to a certain point.

According to recent statistics, we are now, after eighteen months of feverish activity, in a position to produce 88 tons of carbolic acid a day, which is equivalent to about 80 tons of picric acid per day, which in turn is equivalent to about 53,000 shells per day. We recall that in a single day of real fighting the Allies consumed approximately 1,000,000 shells. Were we unequipped with the temporary plants now in service and suddenly confronted by a great war, it would take us 18 months to be in a position to produce 53,000 shells per day. We would have to continue this production for three weeks in order to prepare for a single day of real battle.

It has not occurred to us before to look upon the process of making delicate tints and shades, surely the gentlest of all arts, as one capable of being turned almost over night into a powerful factor of defense. Viewed in this way, is there not every reason why our dye industries should receive the protection they require? It is impracticable to lay by large stores of high explosives. Far better is it to have our ammunition plants kept ever ready for war service by using them in time of peace to manufacture commercial products. If our dye industry were developed to such a point as to produce all the dyestuffs used in this country (estimated at 60,000,000 pounds per year), we would be capable in time of war of producing 100 tons of high explosives, such as picric acid and trinitrotoluol. At an average of three pounds of high explosive per shell, we would be able on a week's notice to produce 67,000 shells per day, which, while not at all sufficient for a battle such as that of the Marne, would at least give us a nucleus of formidable proportions.

The dye industry has suddenly loomed up as a most important element of the national equipment. Its protection and development are of vital importance to the whole country.

Novelistic Science

IT is a paradox that, although science in itself surpasses the most ingenious fiction in sheer romance and in its appeal to man's love of the marvelous, scientific themes are not often successfully used by writers of fiction. In artistic literature science plays a conspicuously small part, considering its immense importance in real life. On the other hand the introduction of ostensibly scientific details has been responsible for a great deal of painfully inartistic literature.

Whatever our grandsires may have thought of Mrs. Shelley's "Frankenstein"—and the tale achieved at least, such prominence that its title has become a proverb—the idea of assembling fragments of humanity from the tomb and the dissecting room and patching them together to produce a living being is intolerably grotesque to contemporary readers of fiction. We have a feeling that the *artistic* way to create Frankenstein's monster would be to begin by manufacturing protoplasm in the laboratory and, by suitable manipulation, to make it develop itself into what one willed. Yet Mrs. Shelley's method is not essentially unscientific. Within the past decade we have witnessed remarkable achievements in the transplanting of tissues and organs from one living body to another, and even their maintenance in a state of vitality outside the body, suggesting that, however crude in detail, the story of "Frankenstein" may be prophetic in its central idea.

A plausible modern version of "Frankenstein" might make a thrilling story, but would it be legitimate art? Is it not true that scientific miracles, even when invested with the air of reality that such writers as Jules Verne and H. G. Wells have been able to compass, never vie in artistic appeal either with portrayals of familiar human experiences or with flights of pure fancy that do not try to justify themselves by an appeal to reason?

The idea of a monster developed in the laboratory *by manipulating and stimulating a mass of protoplasm* is, we believe, more acceptable from an æsthetic point of view than that of one manufactured by Frankenstein's mosaic process, because the former method is more like the process of natural evolution with which, in our generation, everybody is familiar. It is, therefore, more conventional. On the other hand, the far more pleasing story of Pygmalion, who carved a female statue, into which the gods infused the breath of life, bears no relation to nature at all. It is sheer fancy—but is it not also conventional? In the one case we have to do with familiar facts, in the other with familiar fables. The gods were continually metamorphosing human beings into other objects—Daphne into a laurel, Actæon into a stag, Arethusa into a fountain—and the case of Galatea was merely the reverse of this process. Mythology never stoops to explain the scientific details of these miracles.

Does not the incongruity of science with art—so far as it exists—depend upon the fact that art is essentially conventional, and science frankly unconventional?

Naval and Military Notes

Life of a 12-inch Gun.—Sir Robert Hadfield, the noted English maker of projectiles, is authority for the statement that the useful life of a modern high-velocity gun is about three seconds. Which is to say that the time taken by the shell in traveling through the gun, from powder chamber to muzzle, multiplied by the total number of rounds that can be fired before the rifling is so worn as to impair the accuracy, gives a total useful life of only three seconds. Rather a short life for, let us say, a 12-inch gun costing from $50,000 to $60,000.

"Pork Barrel" versus Preparedness.—That was a brave speech of Senator Tillman against the $40,000,000 "pork barrel" measure, known as the River and Harbor Bill. Highly patriotic it was for this veteran party man to come out so boldly for a broad National vision, amid the welter of narrow, parochial talk with which Congress is being deluged just now Such harbor improvements as the deepening of the East River approach to the New York navy yard are of national importance For such improvements, and for none others, should moneys be voted in the present world crisis.

Torpedo Defense for Battleships.—The ever increasing power and range of the torpedo and the inability of the net to stop these terrible weapons have called for some permanent defense, exterior to the ship, which may be carried when the ship is traveling at high speed A substitute for the net is found in providing a fixed outer shell conforming to the contour of the ship's sides and carried several feet distant from the hull, the water being free to pass between the shell and the hull This construction has been used on the new British monitors.

Infantry Steel Helmet Has Come to Stay.—The reintroduction of the medieval steel helmet by the French has been followed by its adoption by the British and the Germans. The helmet is being issued to the British troops at the rate of 50,000 a month It is flatter, or of lower pitch, than the French helmet and has no flutings. Between the helmet and its double lining of felt and wadding is fixed a number of rubber studs which take up the shock of a blow The wadding comes next the head, so that in case of penetration and a resulting scalp wound it acts as a dressing

Powder Pressure in Guns.—The 42 centimeter and other big guns, so often referred to in this war, are howitzers, of low velocity (say 1,000 to 1,500 feet per second) and using low powder pressures in the powder chamber of about 14 tons to the square inch The high-velocity naval and coast-defense guns have velocities of from 2,500 to 3,000 feet per second, and powder pressures of 18 to 20 tons per square inch J A Longridge, the father of the wire-wound gun used so extensively by the English, stated many years ago that guns could be built to stand 80 tons pressure. Maybe, but what about the attendant erosion?

A War Test of the National Guard.—At the very time that Congress was passing its Army bill, authorizing the federalization and enlargement of the National Guard, the readiness of that organization to respond to the call of the country was being put to the test on the Mexican border—with the usual result. There has been delay, reluctance, and, in some cases, positive refusal to respond It is the old, old story of the militia, as recorded over and over again in our military history The experience of General Washington in the Revolutionary War, the breakdown in 1812, the failure in the Civil War, bid fair to be repeated in the present Mexican crisis.

Decisive Effect of Heavy Field Artillery.—The Germans and Austrians foresaw the controlling effect which heavy, mobile field artillery would have in future warfare, and they prepared accordingly Their early successes and their present unbroken front are largely due to their possession of numerous heavy howitzers, of which the Allies, up to the present, have possessed practically none To-day this is being rectified The French are now bringing into service their new howitzers of 14½ inch calibre The British are receiving considerable numbers of their new 11 or 12-inch howitzer Russia has a fair supply, much of which has come from Japan, and Italy, entering late into the war, is relatively the best equipped in this respect of the Allies.

Drydocks for Our New Battle-Cruisers?—The Navy Department is very reticent about the designs of its new battle-cruisers, and the meager information which has been officially given out must have been a reluctant concession to the advertising proclivities of the present Secretary. It seems that the five new battle-cruisers are actually to aim at 35 knots and are to cost some $20,000,000 apiece. If so, they will displace nearer 35,000 than 32,000 tons; and even at that, if they carry ten 14-inch guns, it is a pretty sure guess that the armor protection must be very scant. It is reported that they will be 850 feet long, and for 35 knots they will need all of that. But what about docking them? The new bill should include provision for at least one 1,000-foot dock.

Science

"Fire Weather" Warnings.—The United States Weather Bureau has undertaken a study of the meteorological conditions favorable for the inception and spread of forest fires, and the district forecasters of the Bureau will hereafter issue warnings when such conditions exist. It is possible that special stations will be installed in forested regions in order to facilitate this undertaking

A Practical Suggestion as to Combating Pellagra has been put forth by Dr C W Stiles, a well known authority on this disease, who, in pointing out the need of increasing the use of meat in pellagra districts, urges the more general consumption of rabbits and hares. These animals are prolific, easy to raise, and cheap to feed, and their use does not involve the expense of slaughtering and cold storage, as in the case of larger animals. It is now fully established that diet is a dominating factor in the cause, cure and prevention of this disease, and deficiency of meat in the diet is commonly observed where the disease prevails.

Danger in Spraying Celery.—A note from the U S Department of Agriculture calls attention to the fact that Bordeaux mixture, made of lime and copper sulphate, is much used to prevent the destruction of the Florida celery crop by blight, and that carelessness in the application of this mixture sometimes results in leaving excessive amounts of copper on the stalks This appears to be often due to the use of knapsack instead of power spraying outfits, the former not operating at a pressure high enough to make a fine spray or mist Accumulations of copper are indicated by a blue-green appearance of the base of the celery As this deposit is injurious to health, stalks on which it appears should be thoroughly scrubbed before use, after which there will *be no danger of bad effects*

A Clock Escapement of the 13th Century.—The "verge" escapement employed by Henry de Vick and other clockmakers of the 14th century was presumably evolved from some cruder device, but definite information on this subject has heretofore been lacking Every student of this history of clocks will therefore be interested in the description and drawing of a clock more than a century earlier than those of de Vick, which M Ch. Fremont has recently reproduced in the *Comptes Rendus* from a manuscript dating from the period 1240-1251. It is especially interesting to notice that this early timepiece is provided with a balance wheel, though it bears little resemblance to the immortal invention of Robert Hooke This wheel is ingeniously adjusted so as to be given a to and fro motion by the alternate tension and lateral thrust of the cord attached to the driving weight.

Sharks and Rays as Food Fishes.—An unreasonable prejudice exists in this country against the use of sharklike fishes (sharks, dogfish, rays, etc) as food A recent memoir by Mr Lewis Radcliffe, published by the U S Bureau of Fisheries, points out the flesh of various small species of this class is palatable, when properly prepared, and that this fact is better appreciated abroad than in this country In England and Wales, in 1913, there were landed 64,906 hundredweight of dog fish, valued at £20,242. It appears, however, that a good deal of shark meat is eaten in the eastern United States by people who think they are eating something else For example, trap fishermen in the neighborhood of Woods Hole, Mass., remove the head, fins and tail from all the larger species of shark (except the sand shark) caught in their traps after which treatment the body looks not unlike swordfish It is then shipped to Boston and New York, where it is sold as deep-water swordfish The fishermen receive from 3 to 8 cents a pound for this class of food

The Derailment of Railway Trains By Wind is not an uncommon occurrence in the case of light, narrow gage railways Mr R. H Curtis writing in *Symons's Meteorological Magazine*, tells how this danger has been virtually eliminated on one such line, viz., a stretch of 38 miles along the Atlantic coast of Ireland, forming part of the West Clare Railway Probably there is no other line in the British Isles exposed to such violent gales and during a few years prior to 1909 as many as five "blow-offs" occurred, in which the carriages were completely smashed though there was fortunately no loss of life. In that year Mr Curtis devised for the railway a pressure-tube anemometer, with electrical apparatus for giving two warnings by ringing a bell in the station master's house at Quilty, the first when the velocity of the wind reached 65 miles an hour and the second when it reached 85 miles an hour When the first warning is given, 2,400 pounds of movable ballast, kept for the purpose at every station is placed on each vehicle of any train on the line at the first station it reaches. When the second signal is given, trains are stopped until the storm abates. Since the apparatus was installed, in December, 1909, there has been only one storm-derailment, and this was due to deliberate disregard of the signals

Industrial Efficiency

Serving Lunches to Hold Employees is but one of the many successful plans a Baltimore clothing manufacturer is using at the present time. Lunches are brought to the employees at their machines and benches by a colored maid, who also takes the orders that are filled in the company's lunch room The food is served at practically cost price Not only has the manufacturer found this plan profitable in that the workers materially increase their daily output, but he has also succeeded in obtaining additional skilled help from time to time even in the face of labor shortage.

Crushed Coal in Smelting.—A new method of utilizing coal in competition with oil fuel is being tried at Vancouver Those conducting the experiments claim that crushed coal can be supplied to steam producing furnaces by the same method that oil is utilized The new process is of special interest to British Columbia as it is proposed to apply it for smelting purposes in the big mining plants of the Province It is claimed that seven tons of copper ore can be smelted with one ton of coal by this process, whereas formerly the ratio was a ton of coal to a ton of ore

A Road Contractor's Ingenuity was recently displayed when he converted his chain belt paver into a roller Owing to the fact that shipments of coarse aggregate were delayed on the work at hand, he made use of the time by rolling the entire sub grade with his mixer Over the regular wheels he slipped one half inch steel tires 30 inches in diameter and 24 inches wide The outer half of each tire was filled with cement and sand mixed one to two respectively The entire expense was approximately $75 00, which sum would have been spent in shipping a roller for this work It is reported that excellent compression on the sub-grade was obtained.

Barging Lumber Across the Gulf.—The lumber trade of Cuba and other islands of the West Indies which has been depressed for the past year, is reviving rapidly The demand is mainly for long leaf pine, and it is beginning to move in quantities out of Pensacola, Mobile, Gulfport, and New Orleans The abnormal scarcity of bottoms and prevailing high freight rates are retarding factors to a larger increase in the business Illustrating the straits to which some of the shippers are put and the resourcefulness of some firms, lumber is being loaded on barges at Pensacola Fla, and towed by tugs the 515 miles across the Gulf of Mexico to Havana

"Safety First" in Steel Mill Yards.—There is a tow car now in use in the open hearth stock yards of the Gary Works, which is proving to be a success as an accident preventer The tow car was designed and built at the works so that an entire train of charging buggies can be equipped and operated by automatic couplers, while the danger of switchmen getting their hands caught between draw heads at the engine and buggies is said to be eliminated The end of the tow car next to the engine is equipped with a Jenny coupler and is always coupled onto the engine The other end of the car has an automatic coupler which can be coupled onto the charging cars, all of which have *automatic couplers*

American Clay in Paper Making was the subject of a recent conference between representatives of clay mining companies and of the United States Bureau of Standards. It was shown that several mills in this country were using American clays with excellent results, while several others making the same grade of paper had never been able to use anything except imported clays The facts indicate that part at least of the criticism of domestic clays is due to prejudice in favor of the imported article Foreign clays are said to have a much whiter appearance than the domestic, yet it is definitely known that many imported clays are treated with ultramarine blue, giving them an artificial effect It is proposed to make runs on a paper machine to determine the difference in rate and amount of settling out of the clays, and to make tests for color, per cent of grit ease with which the clays mix with water and other significant tests

Use of Flint Pebbles in Manufacturing.—The flint pebble industry gives occupation to many women and children along the French coast lying between Havre and Dieppe The pebbles collected in and near Havre are selected for their spherical shape and are used exclusively for pulverizing in certain industries, particularly in the manufacture of cement and in copper mines being employed in the interior of large cylinders In the cement industry the slow turning of the pebbles produces a powder which becomes an ingredient of the cement, while in the copper industry the metal is freed of all impurities by the grinding operation The same kind of pebbles is used for crushing purposes in the manufacture of paint Another important use of flint pebbles is in the manufacture of porcelain the pebbles for this purpose being found between Fécamp and Calais. In the latter case the pebbles are pulverized before using

Realizing Industrial Preparedness

An Inventory of Our Resources

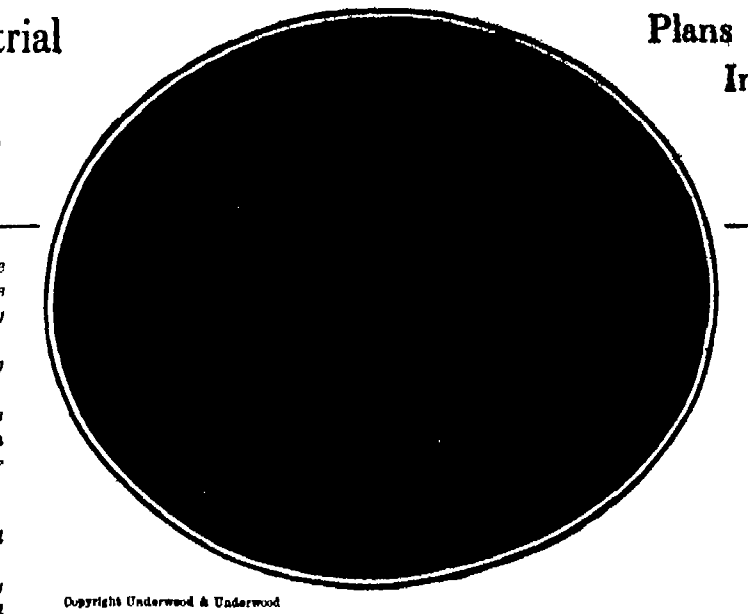
Plans for Mobilizing American Industries in Time of Need

By W. S Gifford

[The author of the following article is the Chief Statistician of the American Telephone and Telegraph Company Mr Gifford is acting as Supervising Director of Committee on Industrial Preparedness of the Naval Consulting Board of the United States, and special interest is lent to what he has written when it is stated that in common with his associates in this patriotic work his time and labor are entirely voluntary

Since the article was written the Army Reorganization Bill has passed the House and Senate While much of the necessary legislation is covered in this bill, it unfortunately fails to provide for the placing of the annual educational orders except "in time of war or when war is imminent so that the legal authority for final and complete realization of Industrial Preparedness is still to be obtained

EDITOR]



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The naval consulting board's committee on Industrial Preparedness

Seated left to right Howard E. Coffin Chairman, W S Gifford, Supervising Director Standing left to right Grosvenor B Clarkson, Director of nation wide educational news campaign W A. McKenzie, in charge of statistical detail.

ONE lesson stands out from the experience of the countries engaged in the European conflict and that is—*that defense is not obtained to-day by fighting men alone but by fighting industries* Behind every man in the firing line in Europe from three to five persons are employed to supply him with food ammunition and other needs To day two thirds to three quarters of all the industries of the fighting nations are engaged in meeting the tremendous requirements of the battle line Phonograph concerns are making shell parts manufacturers of infants food are making plugs for shells, watchmakers are adjusting fuses, in short all kinds of industry are at work doing their part in the fighting line of industry

Whether one is a pacifist or militarist, or among that 98 per cent of the American people who are neither one nor the other but simply advocates of preparedness for defense, no objection can be or is raised against industrial preparedness It is cheap, comparatively simple and accomplished without the clanking of sabers or the glamour of martial spirit It is the foundation for any and every plan of true preparedness for the defense of this nation Its by products in the way of advantages in time of peace make it worth while even though it were not necessary as an insurance against war

The lessons to be drawn from Europe show also the danger and loss due to unavoidable delay in providing munitions if a country is industrially unprepared The necessary steps for industrial preparedness are a cheap enough form of insurance against such possible danger and loss. The accomplishment of true industrial preparedness, as shown by the experience of European countries and of manufacturers of munitions in our own country since the outbreak of the war can be and is being achieved by three steps

First A complete census or inventory of the producing resources of the country In the immediate work in hand this is limited to a complete inventory of industrial manufacturing establishments and principal mines Other resources are needed, but the information already available regarding other resources is more complete than that regarding the manufacturing resources so that their omission for the present from this first immediate step is justified

Second The placing, in time of peace, with hundreds or even thousands of manufacturers, widely distributed geographically, of minimum annual *educational* orders for army and navy supplies. Experience has shown that the one great cause of delay in the quantity production of supplies for the armies of Europe has been the lack of knowledge on the part of the manufacturer as to how the particular article wanted should be made. By making a few of these articles each year in time of peace, the foremen and those holding positions of responsibility, will become acquainted with the peculiarities incident to their manufacture, and the entire organization of the factory, including the purchasing, manufacturing, inspecting, shipping and engineering departments, will be made familiar with the work Payment *for these orders on the basis of actual cost of production*, inclusive of all special tools, jigs, etc, plus a reasonable profit should sufficiently compensate the manufacturer and will go far to supply, at a reasonable cost, the current or peace-time needs of our regular army and navy Every manufacturer carries insurance against fire he must carry insurance against war The inconvenience in handling these small educational orders is a very small price to pay for such insurance.

THE WHITE HOUSE
WASHINGTON

April 21, 1916.

To the Business Men of America

I bespeak your cordial cooperation in the patriotic service undertaken by the engineers and chemists of this country under the direction of the Industrial Preparedness Committee of the Naval Consulting Board of the United States.

The confidential industrial inventory you are asked to supply is intended for the exclusive benefit of the War and Navy Departments, and will be used in organizing the industrial resources for the public service in national defense.

At my request, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Chemical Society are gratuitously assisting the Naval Consulting Board in the work of collecting this data, and I confidently ask your earnest support in the interest of the people and government of the United States.

Faithfully Yours, Woodrow Wilson

A letter from the President of the United States

Third The enrollment of skilled labor in an "Industrial Reserve" in time of peace. The industrial force has become quite as important as the fighting army Skilled mechanics in all lines of production must be kept from enrollment in the army, and in time of war must be retained in the factories, mills and mines for the production of munitions. To this end, these skilled workmen must be listed and the men themselves enrolled in the "Industrial Reserve" The only restriction imposed on the men through such a process will be the prevention of enlistment in the fighting army In the event of war, it is proposed that a button or other distinguishing mark shall be supplied by the Government to skilled workmen enrolled in the "Industrial Reserve," and such enrollment will be considered to carry with it honors equal to enrollment in the fighting forces.

Although not directly concerned in the three steps mentioned, ownership by the Government of certain supplies of tools and gages, which could be distributed in time of war to assist in prompt *quantity* production of munitions, is undoubtedly desirable

The advantages of the foregoing programme to the country as a whole are obvious. The plan is cheap, it results in the education of manufacturers all over the country, and it lays, once for all, the ghost of the munitions trust, for no one firm or group of firms would find it commercially to their advantage to advocate war When it is considered that the producing resources of the United States are greater than any other two countries in the world, and when it is considered that availability of these resources under this plan will be widely distributed geographically, what better insurance against attack could be written? To the skilled laborer the enrollment in an "Industrial Reserve" means that he will not be sent to the firing line but kept with equal honor in the industrial army at home It means to the banker and manufacturer, as well as to the laborer, that unemployment and the suffering therefrom, due to the outbreak of war, will be reduced to a minimum and that all sections of the country will have work to do, labor will be kept on the job and the wrench to the industrial system will be greatly lessened It makes possible, if not probable, the retaining in private hands of the work of supplying the country's needs in time of war and, in this way again, it would prevent any serious disarrangement of the economic system The individual manufacturing plant will, under this educational system, be in a position to swing quickly from its regular commercial line onto that kind of government work for which its equipment has been found to be best fitted

The method for accomplishing the three steps mentioned has been worked out carefully and the end is fast being accomplished It is a most democratic and American way of doing the job A committee of the Naval Consulting Board of the United States, known as the Committee on Industrial Preparedness, of which Mr Howard E. Coffin is Chairman is the directing body This Naval Consulting Board, appointed by the Secretary of the Navy, is non-partisan and composed of men of the highest ability, who act in an advisory capacity to the Government without pay and from purely patriotic motives. At the request of President Wilson, five great engineering societies—the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Chemical Society—have pledged their assistance to the work of the Committee on Industrial Preparedness. The first immediate step is to take a census of our industrial resources. For the accomplishment of this, the five engineering societies have each nominated one man in every state to represent them in the work within that state. These five men in each state constitute a Board of Directors for the state and have been formally appointed by the Secretary of the Navy as Directors of the Organization for Industrial Preparedness and Associate Members of the Naval Consulting Board. These Boards of Directors have all organized, held meetings, appointed their chair

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The Technically Trained Foreman

How One Deficiency of Our Educational System is Being Made Good

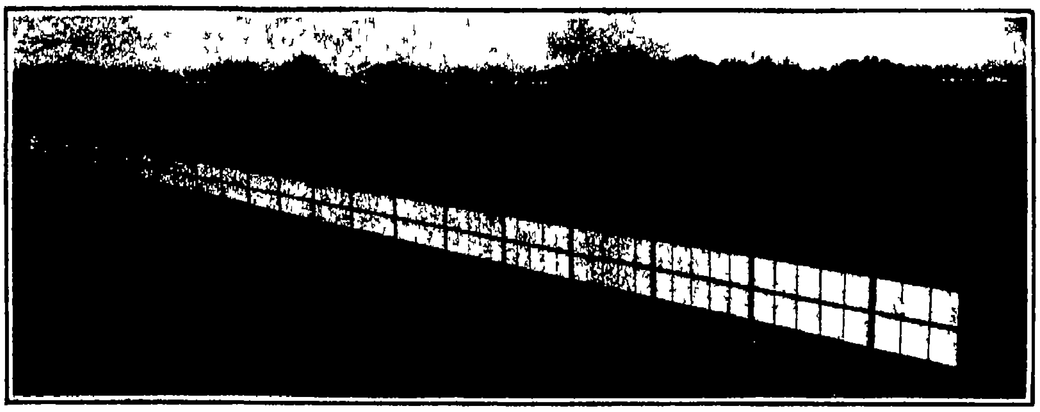
By Allan Rogers, Pratt Institute, Brooklyn, N Y

FOR the past few years the attention of manufacturers and educators has been drawn to the problem of training young men in such a manner as best to fit them for our great and rapidly growing chemical industries. The conditions arising are being met in part by the excellent courses in chemistry and chemical engineering offered by our technical schools and by the magnificent research work being done in some of our leading universities, while in certain lines the trade schools and vocational institutions are playing an important part.

But between the research chemist and the chemical engineer, on the one hand, and the skilled worker on the other, there exists a field which is not being filled by men who have had a training along any of the lines mentioned. This field relates to the supervision, by foremen, etc., of operations carried on in the plant. These positions, as a rule, are held by men taken from the works. In the majority of cases they are ignorant of the basic principles involved and are often not in sympathy with the ideals of the scientifically trained man. It often happens that a great part of the chemist's work goes for naught because of the tendency of the "practical man" to discredit anything that may have been suggested by the chemist of the plant. And, on the other hand, the chemist is apt to look severely down upon the ignorant practical person, and refuse to take his problems seriously. In either case the chemist is worse than useless. The more he understands of the manufacturing operations with which he is concerned, the more valuable he will become to the owners of the plant, and when he goes into the factory he must meet with coöperation, not with opposition and abuse. This condition, however, will never be obtained until we have provided our factories with technically trained foremen, for then we will have a class of men who will be in sympathy and work in harmony with the chemist.

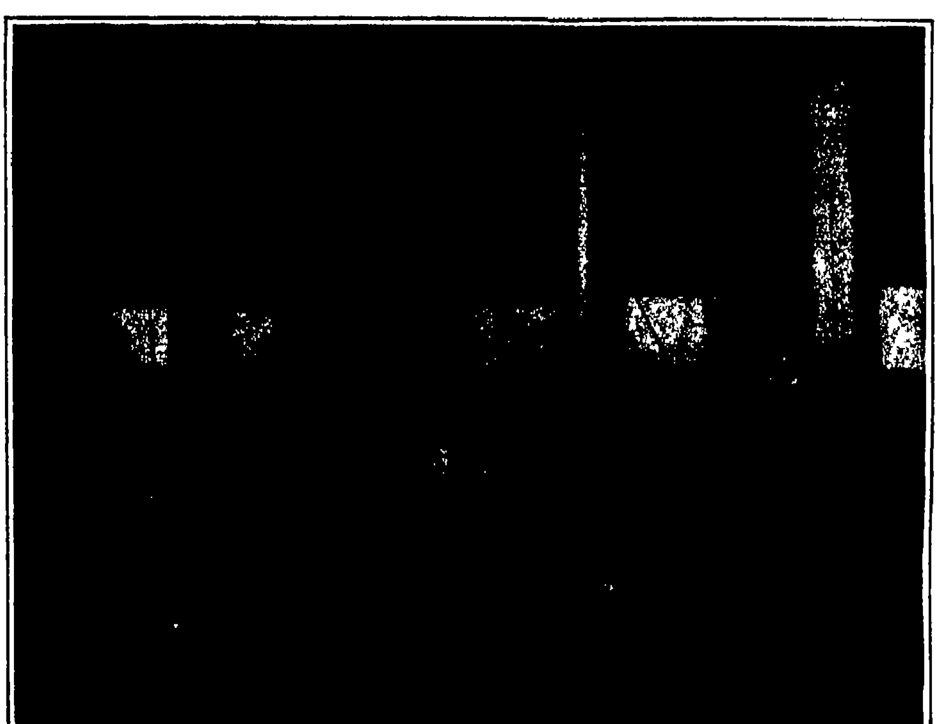
To bring about this condition we will be forced to consider more seriously the question of industrial education for the great army of workers who fill these minor though very responsible positions. It may not sound so musical to the ear or tickle our imagination of the glorious so much to talk about training of foremen as it is to speak of the beautiful ideals of higher education, but our glorious ideals and higher education will be of little value if we do not have intelligent supervision of the wonderful processes we have so ably devised. How can we expect untrained, unskilled and even ignorant workmen to understand or execute complicated processes developed only by years of hard thought and untiring effort?

The colleges and universities are steadily increasing their requirements and are continually raising their standards in order that they may develop the highly trained scientist and investigator. Thus our educational institutions have been turning out thousands of young men each year many of whom have found their way into lines of industry. These young men have become the backbone of the industry into which they have entered and have built up a magnificent structure of which we are justly proud. We cannot help but wonder however if the market is not becoming flooded with an over-production of material for which we have only a limited demand. For every position as research chemist or laboratory worker there are scores of places as foremen or superintendent, equally remunerative, equally desirable scientifically, far superior in prospects of advancement. And yet no effort is made to prepare even superficially for these positions.



Test fence painted with paint from Pratt Institute

Scientific education is of value to mankind only in so far as it can be applied to the benefit of humanity, but to apply this scientific knowledge requires men who are fitted to do so. The greatest discovery is worthless unless properly applied. We are training too many discoverers and too few men to put their discoveries into application. Hundreds of plants are crying for intelligent supervision. These plants offer positions of responsibility and trust which should be and in the future will be, filled by men with technical training. When the time comes that we have men in our plants who can think along technical lines and who can work in harmony and in sympathy with technically trained men higher up we will be able to get the full benefit of the research chemist's knowledge, carry out the ideas of the chemical engineer and profit by the findings of the works chemist.



Model paint factory at Pratt Institute

In dealing with this as with any productive problem the first and most important matter to consider is that of raw material. Where shall we get this raw material? The answer is an easy one. We should look for it in the high schools of the country. The majority of young men and young women are in a very receptive mood at about the high school period in their career; this is the time to impress upon them what the future may hold in store. A good impression and a created interest at this critical period would cause many an uncertain youth to turn the latter part of his high school course into new channels where he could more clearly see his way to advancement and prosperity and economic service. The manual training system, as conducted in many schools has this end of view but falls short of the mark in that it brings out only the mechanical side of the problem. To accomplish the result desired in the writer's mind it would not be necessary to convert our high schools into trade schools but merely to pay a little more attention to the practical things of every-day life.

Few indeed are the high school students to-day who realize that the United States is the greatest manufacturing country in the world, and it is safe to say that not one out of a hundred knows that every article of his clothing, the food he eats, the paper upon which he writes, the pavement upon which he walks and the decoration of his home are the result of chemical industry brought to perfection through chemical treatment and control. These things should all be brought out. In addition to the simple facts as ordinarily taught in a course of general chemistry the teacher could impress upon the student that each item has some practical application and frequently the class might

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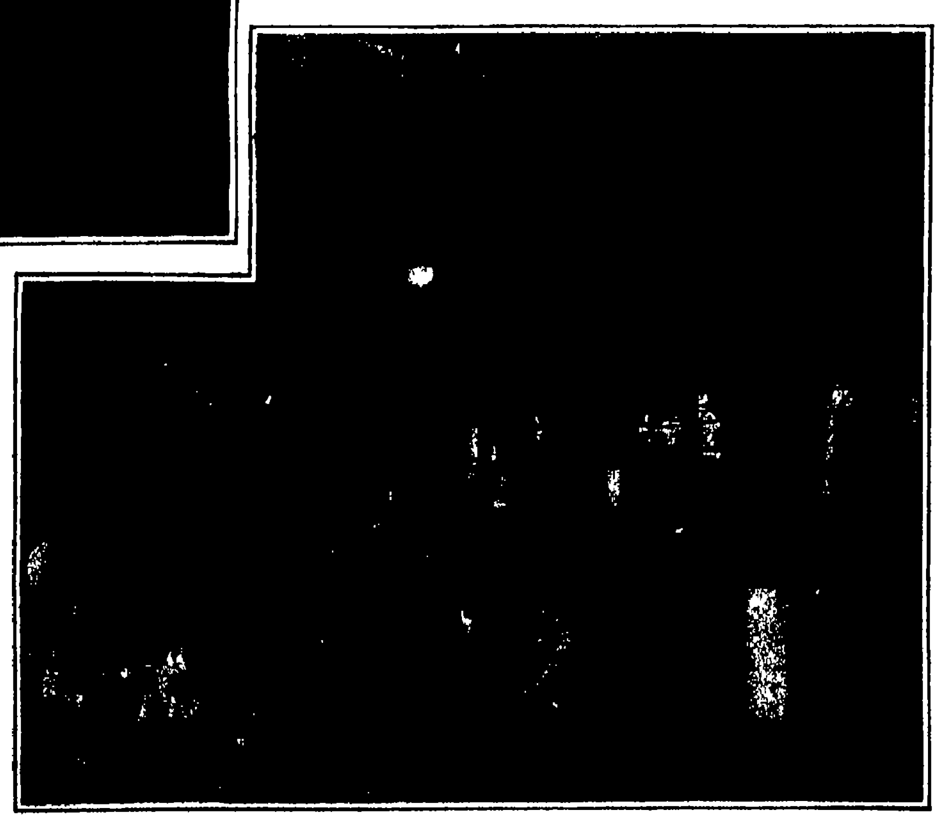

Students from tanning course doing construction work in new tannery

A Census of Colors

What the Government is Doing to Aid the Dyestuff Industry

By Prof. Thomas H. Norton, Ph.D., Sc.D., Bureau of Foreign and Domestic Commerce, Wash. D. C.

THE idea conveyed by the word "census" was, until a recent period, of an extremely restricted nature. For centuries it was limited to the simple enumeration of the population.

During the nineteenth century the scope of a national census was gradually broadened, until now, in most civilized countries, it embraces a great variety of data. The population is not simply numbered, it is also classified from many standpoints, nativity, literacy, marital condition, occupation, etc. Our Bureau of the Census studies every phase of the material, industrial and intellectual life of the American citizen. Each ten years it takes a complete inventory of the nation's wealth and assets.

New subjects for careful enumeration and classification are making their appearance, as sociology and economics seek concrete forms of expression. Census-taking is no longer an exclusively national function. It is frequently executed by state or local officials, or on private initiative.

The recent census of wild birds is an interesting example of a novel and fascinating field for statistical study.

Almost as picturesque is the latest subject for census taking undertaken by one branch of our Government. It might be termed by a feuilletonist as the rainbow census. In fact it deals fundamentally with the infinity of tints constituting the visible spectrum of the solar rays, included between "ultra red" and "ultra violet."

In more prosaic phraseology it is termed a census of the coal-tar dyestuffs consumed by the American people, and it is compiled by the Bureau of Foreign and Domestic Commerce.

So much interest has been excited in chemical circles by the announcement of this new phase of the Bureau's many sided activity, that a detailed statement is in order.

Necessity of the Census

The necessity for a complete enumeration of the artificial coloring matters regularly consumed by the various manufacturing industries of this country soon became evident when these branches were threatened in 1914 by a dyestuff famine, as a result of the great European war.

Those who took into careful consideration the possibility of creating an independent American coal-tar dyestuff industry were obliged to study closely a number of factors bearing upon this exceedingly complicated question.

Among these were such items as the supply of crude materials, the chemists and chemical engineers available, the probable attitude of the European interests hitherto furnishing our synthetic dyes upon the return of normal international conditions, the requisite fiscal and other legislation essential to safeguard American enterprise and capital against unfair competition on the part of such foreign rivals, etc.

First and foremost, however, came the factor of *quantity*. What is the total annual consumption of artificial colors in the United States? How many different dyes are in current use? What is the average annual consumption of each of these dyes?

The necessity of exact information on these three points is self-evident to some. For most a brief explanation may be helpful.

In a general way we know how the great dyestuff industries of Germany and Switzerland are organized. We know the relations of capital, of technical staff, etc., to output. From an economic standpoint it is necessary to know the total extent of the American market for this class of wares, in order to estimate approximately the amount of capital required for a comprehensive industry, the number of trained chemists and engineers needed and the quantities of coal-tar crudes to be provided. These form the main links in the chain connecting the gas works and the coke plants yielding coal tar and the gases laden with benzene and its homologues, with the multitude of mills and shops in which synthetic colors are employed to produce chromatic effects upon wares of the most varied nature—paper, textiles, leather, wood, ink, varnish, fur, feathers, foods, beverages, etc.

While such leading data are of prime importance from a general economic standpoint, of still greater value are the details concerning the specific products of the synthetic color industry.

There are nearly 1,000 coal-tar dyestuffs of recognized standing in the tinctorial world. Many of these are encountered commercially in the form of several marks or brands. These represent slight modifications of the primary dye, some times in regard to shade, often in regard to convenience of application. The form in which a dye is prepared for use on cotton may not be the best form for the needs of the silk dyer. The requirements of the feather dyer may be quite different from those of the manufacturer of ink.

It is essential that the organizers of a national color industry must know, with a certain approximation to accuracy, how much annually is consumed of each primary dye, and how much of each minor modification is employed. Without such data he is at a loss to calculate the size and number of the units to be constructed for the production of any given dye, and he is at an equal loss as to the equipment necessary to manufacture it in the different modifications of current use.

Again the industry is one of great complexity, involving a high degree of coördination and of careful planning to avoid material loss in the way of by-products. In the various steps intervening between a coal-tar "crude," and a finished dyestuff each chemical reaction in the sequence is apt to produce certain percentages of closely allied compounds, isomeric substances as a rule. These latter may possess the same general chemical composition as the product more directly sought. The arrangement of the atoms in the molecule is, however, quite different. As a result, physical and chemical properties are totally unlike those characterizing the main substances. By-products possess as a rule, distinct technical and commercial value. One may serve to make an entirely different dyestuff, another may be the raw material for manufacturing a valued medicinal, a third may be employed in the production of a photographic developer, etc.

It is evident, therefore, that the establishment of a synthetic color industry means an elaborate study of a multitude of interrelated operations, allied further more with numerous products in a group of closely connected industries, based likewise upon the use of coal-tar crudes. To some extent the changing whims of fashion enter into play. Back of every plan and calculation stands, however, the dominant factor of *quantity*.

It is now generally recognized that any intelligent effort to build up a comprehensive, self-contained American coal-tar chemical industry must rest upon the solid foundations of accurate statistical data concerning the American market for artificial colors. In no other way can the creators of such an industry avoid duplication, over-lapping, waste and blundering, tentative struggles to adjust productive mechanism to a vague, indefinite demand. Without such fundamental data the future industry would be heavily handicapped by permanent overhead charges, accumulated as the result of being forced to feel its way in the dark, chemically, mechanically, commercially.

If the coming American dyestuff industry is to hold its own successfully against foreign competition it must be free from any unnecessary shackle. It must start into existence during these years of crimson splashed struggle for Europe—of golden opportunity for this Republic—at the point where a brusque order to halt has been given the giant factories on the Rhine, the Main and the Spree. It must utilize to the full all the gathered stores of experience, accumulated during the six decades since Perkins's epochal discovery and become a world factor in the seventh period of the history of synthetic color at whose portal we now stand.

The data of quantity constitute the warp. The shuttle of American enterprise and talent will flit swiftly back and forth carrying the threads of past experience, weaving the many-colored fabric of the nation's new industry.

Early in 1915, the embargo came into force, shutting off German dyes from this country. Long before, the relatively small supply of colors, from England, France, Belgium and Holland had practically ceased, and the somewhat more important source in Switzerland was threatened with paralysis.

The Bureau of Foreign and Domestic Commerce in Washington was following with the keenest interest, and even with anxiety, the initial steps taken bravely and resolutely by a small band of far sighted American men, some manufacturers, some capitalists—all patriots—convinced that finally the opportunity had arrived, to build up a genuinely national coal-tar chemical industry.

In the earnest desire to second their efforts and facilitate their plans, as well as to ensure the most favorable and economical conditions for the rapid evolution of the new industry on a permanent basis, it was promptly recognized that nothing could be of such direct assistance as a "census" of the dyestuffs consumed normally in this country. Plans were carefully laid to carry out the work as expeditiously, accurately and fully as the very limited appropriations at the command of the Bureau for such general purposes would permit.

How the Census was Taken

First of all it was necessary to decide upon the *modus operandi*. It has been suggested by some who had early recognized the desirability of such a "census" that the only available method for securing the needed data was to appeal to all consumers of artificial colors for their coöperation. It was thought that a ready response would be given to circular requests for detailed information regarding the annual consumption of coal-tar dyes by each user of the same. It was proposed, in order to overcome the customary repugnance of manufacturers to communicate facts of this nature, that the replies should be sent to some central financial institution, which would guarantee secrecy in collating the numerical data received.

A careful analysis of the problem showed that any such method of collecting data was impracticable. It would be impossible to secure a complete list of all users of dyestuffs, in scores of trades and manufacturing branches. Assuming that figures could be secured from *all users of colors* their compilation would be a herculean task. Suppose that five tons of Congo red are consumed annually in this country. This amount might be divided up among several thousand consumers in lots ranging from five to one hundred pounds.

With a somewhat elementary knowledge of human psychology it was furthermore certain that no replies could be expected from the great majority of the recipients of circular requests. Indifference, suspicion or pure laziness are serious factors to overcome.

The correctness of this conclusion has recently been abundantly verified by transatlantic experience. British textile and allied interests have been forced to deal with a far more serious "dyestuff famine" than has been the case in the United States. There was a similar determination to build up a genuinely national color industry. The necessity of a dyestuff "census" was likewise recognized as of paramount importance. An influential committee, representing makers and consumers of dyes, took the matter in hand. Appreciating the futility of dealing directly with the multitude of individual users of colors, the committee decided to collect its statistics through the various powerful organizations of trades employing large quantities of dyestuffs and then double the results, thus roughly approximating at the entire national consumption of the various colors. After months of labor the committee has been forced to report a practical fiasco. Replies were secured from but nineteen associations or large individual consumers. The figures obtained covered but 3,145 short tons, perhaps 12 per cent of the national consumption.

The method adopted by the experts of the Bureau of Foreign and Domestic Commerce was much more simple, direct and accurate. As in the case of Great Britain, nearly nine tenths of the normal American consumption is derived from European sources. It was decided to use the data covering the imports of artificial colors into this country during the 12 months ending June 30th, 1914—a month before the outbreak of the present war. The remaining tenth is covered by the returns of the Bureau of the Census for the domestic coal-tar dyestuff industry, covering the production of the calendar year 1914. No serious interference in the output of American colors occurred until after the beginning of 1915.

With the cordial coöperation of the Secretary of the Treasury, all the invoices for the year in question were sent by the Collectors of Customs at the various ports of entry to a central point, where the essential data were transcribed. These include weight, value and price. Some 37,500 different entries, each covering these three items, were necessary.

These entries are found under about 6,500 heads, each representing a distinct commercial designation. It must not be inferred, however, that 6,500 different colors come into consideration. Many standard dyes are manufactured by a number of firms in the same country as well as in various countries. Frequently, several or all of the competing manufacturers use entirely different trade names for identical wares.

Thus, the red color, known chemically as sodium α-naphthalene-azo-α-naphthol-disulphonate, is manufactured under the name of Palatine Red by the Badische Company. The Bayer Company sells it under the name

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Strategic Moves of the War, May 26th, 1916

By Our Military Expert

IN contrast to the lack of the spectacular which the late weeks of the war have demonstrated, the week just passed has been marked by the development of a great Austrian offensive in the Trentino, the resumption of terrific attacks by the Germans upon Hill 304 and Mort Homme and the reported junction of Russian cavalry with the British forces in Mesopotamia, in the vicinity of Kut el Amara.

The Austrian campaign in Italy has not as yet developed sufficiently, nor gained enough material ground to render analysis of the operations feasible, for at this distance and with only the meager reports which have been permitted to pass the various censor ships, little is now known in this country of the actual situation.

Almost inch by inch, by dint of an arduous campaign which covered months, the Italian forces had pushed their lines closer to Rovereto in the campaign against Trent. In ten days, an Austrian force estimated at 300,000 men, backed by a powerful massing of artillery superior in numerical strength and caliber to the Italian, has thrust back the forces of Italy along a front of approximately 60 kilometers, to a distance varying from that between two lines of trenches to eight or nine kilometers, while east and southeast of Rovereto, the Italian frontier has been invaded in at least three places.

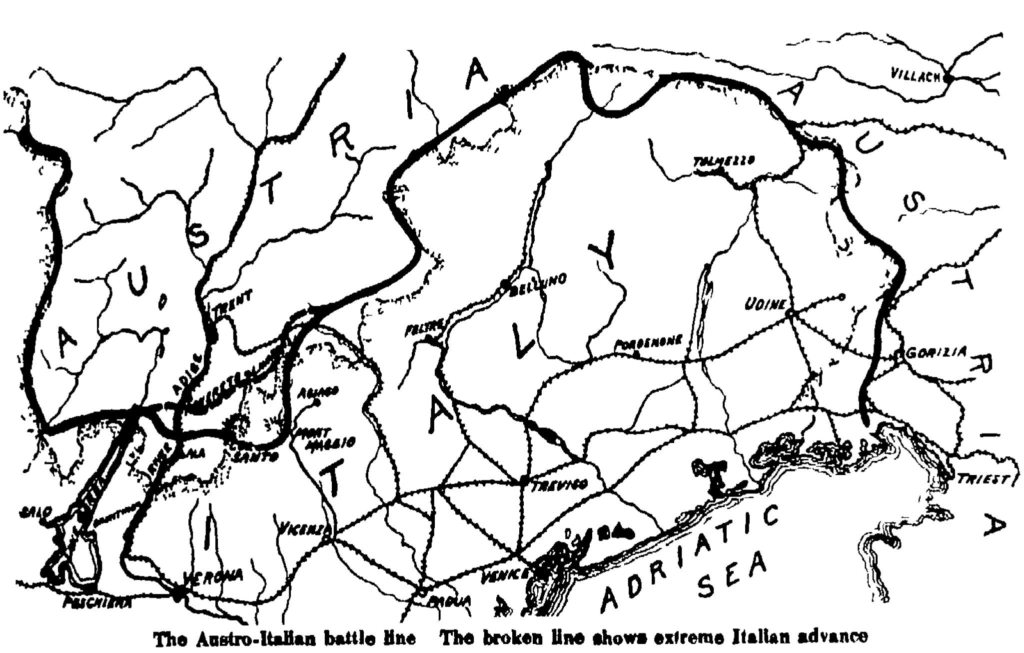
Austrian forces are reported to dominate the entire Lavarone plateau, with the Col de Santo and Monte Maggio, commanding eminences, also in their hands.

This thrust to the south and southeast, if successful, must have for its ultimate military object the isolation of the Venetian peninsula, and when it is considered that the bulk of the Italian army in the field is embraced within this territory, the menace of the attack becomes very apparent. There is a marked similarity between the strategy employed at Verdun and that recently developed in the Trentino. Verdun is in the heart of a salient, both sides of which are subject to attack, either of which might be crushed in by a success, the Venetian peninsula is guarded on the east and southeast by the Adriatic, but the Italian Austrian frontier, which in general coincides with the battle lines, forms the upper leg of a salient. The thrust is at the base of the salient, more directly upon Verona and Vicenza, railway bases which supply the main Italian base toward Gorizia on the east, and to which the greater portion of the Italian army looks for its needs.

The strategy is without doubt of the soundest, a glance at the map will make this apparent to the veriest layman. But because the Austrians have attacked in strength and have gained a comparatively small amount of difficult ground, this does not mean that it will be an easy matter for their forces to sweep onward. The entire territory embraced between the lines is about as difficult as any in existence, and when the problems of transportation and supply are considered, it is clear that even if the Italian defense should materially weaken, an improbability, it would necessitate considerable time even to shift the great guns forward to new emplacements from which to pound to a pulp another position in advance. This massive artillery has been the secret of the entire affair, the war, even from the beginning. The same great howitzers and field mortars which made the Austrian advance against this terrific terrain possible, proved themselves the key which unlocked the defenses of Liège, Namur, Maubeuge and other points. The steel cupolas could not withstand them, but without their great guns, the Germans would have been held at least for a longer time by the Belgian fortifications.

The entire artillery arm of the Austrian forces is greatly superior to the Italian, not only on the Alpine battle line but in general. The Italian field material, practically the same as the famous "Seventy-Fives" of France, is a better gun than any the Austrians have of the same caliber, but the disparity in numbers is great. And while Italy owns a certain number of larger pieces, notable many which have been turned out since the great struggle broke in August, 1914, Austria had a tremendous advantage in this respect from the first and it has been increased in proportion since the outbreak of hostilities. It seems rather evident that Italy has not gone into the prosecution of her war whole-heartedly, apparently being willing to let things drag along, seeming hopeful of making her own immediate gains by a "ride upon the coat tails" of her Allies. Only a few months ago a whole class which had been called to the colors was granted furlough. Italy's attitude is further shown by her strange relationship with Germany, with whose ally she is at war and who is at war with Italy's allies, and Italian reluctance to participate in the Balkan imbroglio when, it is believed, decisive action on her part might easily have saved Serbia, adds point to the complication. It is one of the weirdest situations in all history.

Apparently this sudden swoop upon her by the Austrians is the price Italy must pay for her lackadaisical belligerency. The constant effort of the Central Powers has been directed toward the elimination of at least one national foe, first France, then Russia—without success. Italy being the weakest great link in the alliance, and having been further guilty of keeping about 400,000 Austrian troops from the Russian battle line, now comes in for her turn, with always in view the possibility of a success which would release these Austrian troops for service elsewhere a tremendous gain for the Kaiser when it is remembered that reserves are become exceedingly scarce. And a victory over Italy would strike a rather stunning blow to Entente morale and possibly effect the same gain which was hoped for in the event of a decision favorable to Teutonia accruing at Verdun.



The Austro-Italian battle line The broken line shows extreme Italian advance

Italy is not so far damaged by the invasion save in her pride and possibly in morale, her Allies suffer from this, in this respect, as much as she. But as things do not always pan out as anticipated, there may be a hoist with the attacker's own petard, exemplified by a full arousing of the Italian people and authority to the danger of dilatory methods and the real threat which seems to confront their state. The greatest saving factor the Italians have is that of time—the time which is necessary for the shift of the guns. The hoist would come if Italy should be so awakened by her danger that the nation would respond to a man and really go to war, thereby preventing a later detachment of Teutonic troops to other points, upsetting plans of strategy which challenge the awed admiration of the world.

There is another reason which may account for the sudden activity against Italy. So far, the Central Empires have retained the initiative, a tremendous advantage in war, for it keeps the enemy in doubt, makes him chary of changes of disposition of troops and compels him to follow the lead of the country on the offensive. Verdun, it seems rather definitely settled, has not yielded the fruits expected, hoped for, to the Kaiser, the dominant factor in his alliance, but the German staff has no mind to relinquish its initiative advantage on that account and, in consequence, Italy may serve to retain this. The forces of the Entente have been steadily gaining strength in relative man power and material, evidently in anticipation of the wresting of the initiative from its foes. The Entente may assume the role of the offensive almost any day, but it will not be a true offensive so long as Teutonia is attacking for it must first represent only a counter attack, an offensive return.

At Verdun the Crown Prince continues his efforts to break in the French salient at Hill 304 and Mort Homme. It seems a hopeless task, so often has he failed, but stranger things have happened in war than the sudden collapse of a stout defense.

French activity has been renewed and the latest dispatches indicate the recovery of Fort Douaumont, the only permanent fortification of the Verdun enceinte which has fallen into German hands. As a point of military value, Fort Douaumont is nothing, but from the standpoint of sentiment which makes morale—its recovery means much to France. Whether the French forces will manage to retain it is another question which only the future can answer.

The junction of Russian cavalry with the British in Mesopotamia appears to be a brilliant and daring feat of arms. In all probability this force has made its way from the vicinity of Kermanshah, probably by a wide detour to the southward threading the dubious passes of the forbidding mountain range which parallels the Persian Turkish frontier in Luristan east of Bagdad. There is nothing to indicate whether this is merely a detached flying column or the immediate precursor of a strong infantry advance of which the Russian force that effected the junction is but the advance cavalry. How such an army could subsist and be supplied with munitions is a wonder. But there have been many wonderful things evidenced in the Grand Duke's campaign and it is not inconceivable that instead of a decision being reached on either eastern or western main front the conquest of Turkey with the elimination of that country from the Central Alliance, might materially aid in bringing the entire war to an end.

Italy has a defense far superior to what she herself can put up if the Entente begins a widespread mass terly consistent offensive. But the question is

Is the Entente ready? In men? Supplies? Ammunition?

Resurvey of the Massachusetts Coast With a Wire Drag

THE United States Coast and Geodetic Survey is about to make a resurvey by the wire drag method of Massachusetts Bay between Nahant and Cape Ann and of the western part of Cape Cod Bay between Plymouth and the Cape Cod Canal. This method has been in use for 10 years on the coast of New England and has had important results in the Maine bays, Boston and Cape Cod bays, Buzzards and Narragansett bays and the East River, New York. It is in use in Alaska with marked success, and has been employed in Florida, Porto Rico and Panama.

The surveys in the vicinity of Boston last year had such important results that the work is to be continued. Several new buoys are in position, some of the old buoys have been shifted, and the accepted deep channel to Cape Cod Canal is more than a mile farther offshore than previously.

The wire drag consists principally of a long wire suspended at known depths below the surface by vertical wire cables, connecting buoys on the surface with suitable sinkers. It is towed by launches, the purpose being to place the wire at the proper depth to catch on all obstructions of less depth and to pass over all of greater depth. The maximum depth selected for the area to be dragged is 50 feet at mean low water or 58 feet at high water, wherever such depth exists. In Salem and Gloucester harbors the maximum depth will be 33 feet at mean low water.

The object of the announced work is to insure the safety of all vessels bound to or from the Cape Cod Canal, vessels bound eastward from Boston, and those entering Salem, Beverly, and Gloucester harbors.

Chestnut extract plant, North Carolina

Palmetto growth in Florida

Cutting hemlock, Tellico Plains, Tenn.

Our Present and Future Sources of Vegetable Tannins

Where the American Tanner May Hope to Find an Independent Supply of Raw Materials

By Samuel J Record

THE tanners and dyers of the United States use annually about $25,000,000 worth of vegetable tanning materials, of which nearly one third is imported Formerly our tanners had the virgin forests to depend upon and their use of tanning material was limited to oak and hemlock bark The peel of these barks has gradually become more restricted and less accessible though they still remain a great source of supply Meanwhile there has been a constant increase in the production of leather making other sources of tannins necessary For tanning certain grades of leather this demand is being met in part by the use of chemicals, synthetic tannins are also being perfected Nevertheless the demand for vegetable tannins continues, especially for the tannage of sole leather harness leather and belting

One of the first developments to meet the changes in the tannin situation was the making of chestnut extract Over two thirds of all the tannic acid produced in the United States is from chestnut wood and bark The value of the extract consumed annually is about $4,000 000 The industry is confined largely to the South where the tannin content of the wood averages over 8 per cent, occasionally running as high as 12 per cent. Chestnut in the North does not contain a sufficiently high percentage of tannin to make its extraction profitable at present Chestnut extract is used extensively in mixture with oak bark tannin for the preparation of leather of medium grade The future of chestnut as a source of tannin is uncertain owing to the blight which threatens the commercial extinction of the tree

The introduction of quebracho extract has done much to supply the demand for tanning material This extract is made from the wood of a tree (*Quebrachia lorentzii*) found in southern Brazil, Paraguay and Argentina The heartwood yields from 20 to 24 per cent of tannin, the sapwood from 3 to 4 per cent and the bark from 6 to 8 per cent Quebracho extract does not contain enough of the non tannin materials to produce of itself well nourished leathers and is, therefore, used in mixture with other tanning materials It was first introduced into this country in 1897 and within two years the amount used here was worth approximately $300,000 In 1906 the value of the total quantity used amounted to about $5,000 000, and in 1909 to nearly $6,000,000 The value since has remained fairly constant In 1909, quebracho extract formed 38 per cent of the total quantity of extract consumed in this country and its cost constituted 54.5 per cent of the total cost of the extract used The average cost per pound of the quebracho extract was double that of chestnut extract

Red mangrove bark and mangrove extract are also imported in large quantities In 1909, 19,000 tons of bark worth over $500 000, and 1 400 000 pounds of the extract valued at nearly $44,000 were consumed by our tanners The use of this product is rapidly increasing and the price has risen materially in the last two years During 1915, over 2 000,000 pounds of extract were shipped from Cartagena, Colombia, to the United States, invoiced at 2½ cents a pound Owing to the growing demand the price of mangrove extract from that port was 250 per cent higher than in 1914 An important mangrove industry has recently sprung up in Trinidad, British West Indies Prior to midsummer of 1915 only small quantities were exported, but during the latter half of the year nearly 2,400,000 pounds valued at $16,800 were shipped to the United States

Red mangrove is native to the tropical tidal marshes of both hemispheres, but our present supply is derived largely from the West Indies and Portuguese West Africa Along the Gulf of Mexico, mangrove yields, when properly cured about 30 per cent tannin, that from Africa about 40 per cent, and the East Indian and Borneo mangrove between 30 and 40 per cent. It is not generally appreciated that in extreme southern Florida the shores are fringed with thousands of acres of red mangrove trees. Efforts to utilize this supply have been abandoned for the present, as the cost of collecting the material from the tidal swamps was too high There appears to be no valid reason why, with the introduction of more efficient methods, this important source of tanning material could not be made readily available for commercial use in quantity

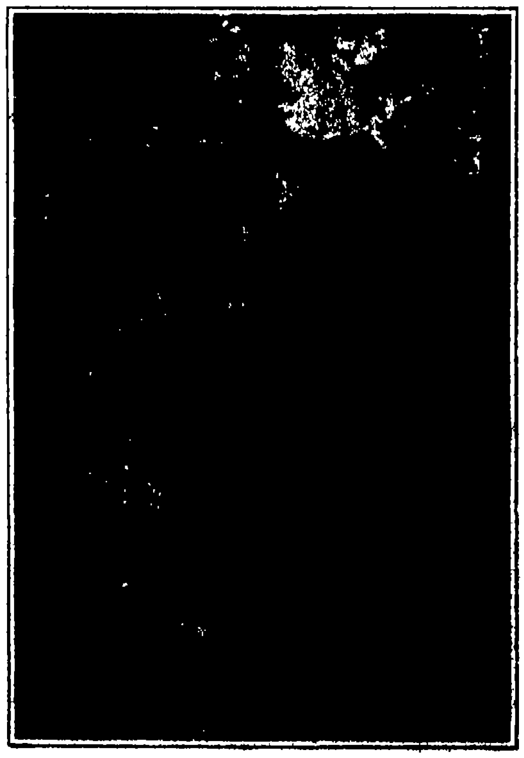
There are numerous other trees in southern Florida which should repay careful investigation regarding their tannin content The black mangrove (*Avicennia nitida*) grows there and produces a bark rich in tannin This species is used extensively in British and French Guiana where it is known as courida. The white mangrove (*Laguncularia racemosa*) has much the same range as the red and black mangroves and is closely allied to South American species yielding bark valuable for tanning The seaside grape (*Coccoloba uvifera*), the Jamaica black olive (*Bucida buceras*), the hog plum (*Spondias lutea*), and others are products of the subtropical regions of Florida that offer possibilities for the tannin supply of the future

One of the most convenient natural sources of tannin is the fruit of *Terminalia chebula*, known as myrobalan nuts In 1909, we consumed 18,000 tons of these nuts valued at about $30 a ton, and 1,100,000 pounds of myrobalan extract worth $37,500 Myrobalans are used extensively for dyeing as well as for tanning purposes The tannin content of the husks is about 45 per cent and that of the stones between 4 and 5 per cent In 1910, India exported 73,355 tons of these nuts. Myrobalan extract gives a soft tannage of rather light yellow, and is generally used in combination with other tanning materials to improve their color

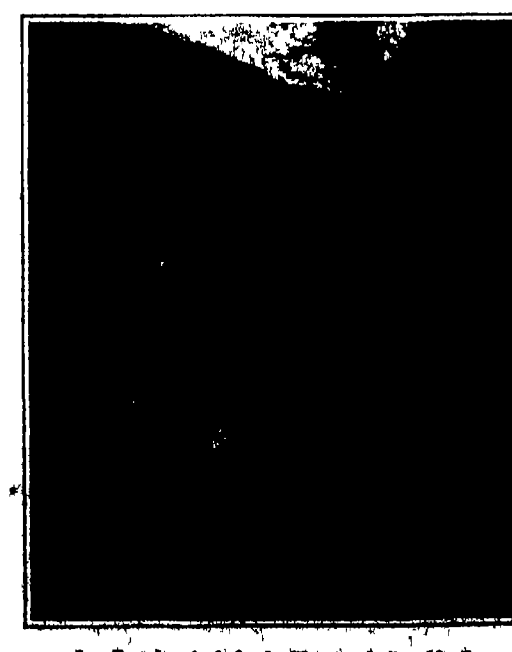
Gambier is the dried extract from the leaves of *Uncaria gambier* and *U acida* It is exported from Singapore in pressed blocks and cubes In 1914, this country consumed 16,450,000 pounds of gambier costing approximately $625,000, while in 1909 the amount was only 2,640,000 pounds and the value $134,000 Gambier contains from 36 to 40 per cent of a brown tannin which rapidly penetrates leather and tends to swell it, but taken alone produces a soft, porous tannage, it is used generally in conjunction with other materials for tanning both light and heavy leathers. It is important also as a dyeing material

Cutch is a product obtained from boiling the chips of the heartwood of *Acacia catechu* Good cutch contains about 60 per cent of tannin but it is used largely for dyeing browns and blacks with chrome and iron mordants. The product imported under the name of mangrove cutch is an extract from the bark of the mangrove tree The mangrove cutch is not intended

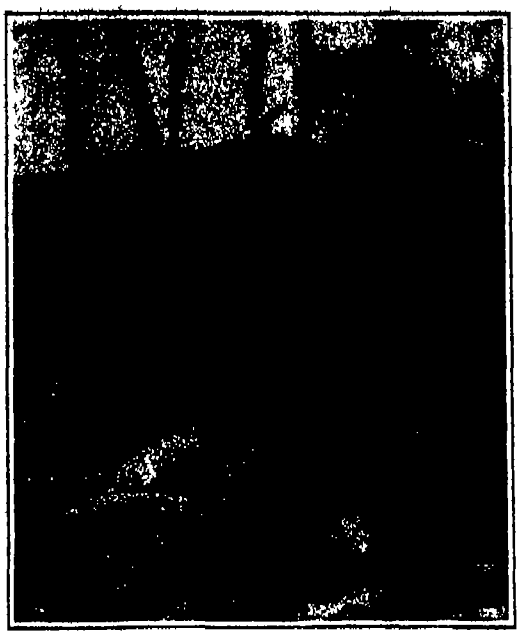
Stripping hemlock bark, Haywood Co., N C



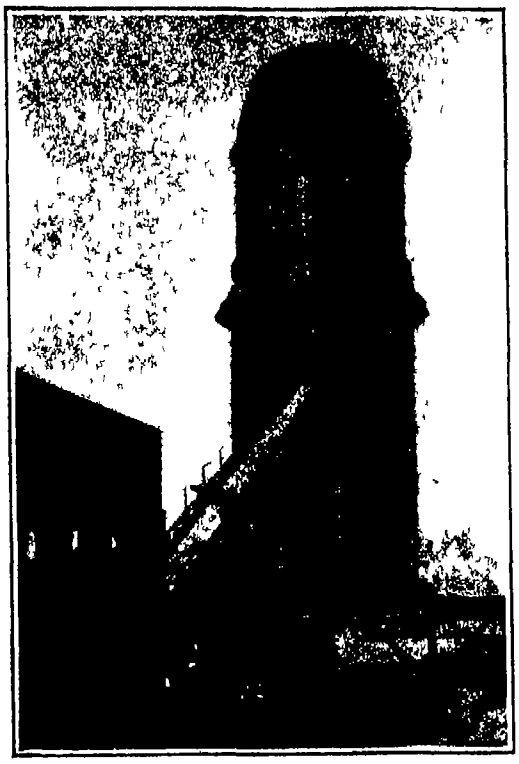
Tanbark, oak growth, Mendocino Co., Cal.



Loading hemlock bark, Haywood Co., N. C.



Hemlock bark awaiting shipment, Blount Co., Tenn.



Refuse burner of large saw mill, consuming much possible tannin-producing material

Corded chestnut (for acid and pulp) Old Fort, N C

for use as a dye and its absence of color is one of its chief characteristics

Valonia is the commercial name for the large acorn cups of certain foreign oaks, principally *Quercus ægilops* An extract is made from these cups, which in solid form contains as high as 58 per cent tannin It is used in mixture with other materials because by itself it produces too brittle a leather In 1914, 7,054,000 pounds of this extract costing $116,400 were used in the United States, as against about 244,000 pounds costing $18,000 in 1909

Gallnuts are excrescences produced chiefly on oak trees by the punctures of the gall fly for the purpose of depositing its eggs The principal commercial kinds are oak or Aleppo galls and Chinese galls The former develop on the buds of young branches of oak trees and, when collected while the fly is still in its larval state, contain from 60 to 70 per cent of gallotannic acid The Chinese galls are produced on the leaves of a sumac and the best grade contains about 70 per cent of tannin Galls are imported in rather small quantities both in a crude state and in the form of extract. According to the figures of the Department of Commerce there were shipped into this country in 1914, 47 845 pounds of the extract valued at $5,900, and 157,285 pounds of nuts valued at over $19,000

Divi-divi is the trade name for the seed pods of *Caesalpinia coriaria*, a small tropical American tree These fruits contain from 30 to 50 per cent of a tannin somewhat similar to that obtained from valonia. In 1914, about 22,000 pounds valued at about $16,000 were shipped into the United States A closely allied species, *Caesalpinia brevifolia*, a native of Chili, produces pods very rich in tannin They are known as algarobilla.

In 1913, this country imported 14,500,000 pounds of ground sumac invoiced at $300,000 Nearly all of this was Sicilian sumac, which contains about 28 per cent tannin. The Sicilian harvest of this material has decreased from 60,000 tons at one time to half that amount at present. Sumac tannin is valuable for making fine leathers for gloves and for boot bindings. It is also used for the re-tanning and currying of heavy leathers Another important use of the extract is the mordanting of the basic aniline dyes which require a preliminary fixing bath, especially for fixing methyl or methyline green shades in cotton fiber

There is an almost unlimited supply of sumac in this country, but it is not prized as highly for tanning or for dyeing as the Sicilian product, owing to the much darker color It comes mostly from Virginia and surrounding country where the two principal species, the smooth sumac (*Rhus glabra*) and the staghorn (*Rhus hirta*), attain their best development Both of these also grow plentifully farther north but the tannin content of the northern grown material is lower Only the leaves and long leaf stalks are of value, the berries and old shoots being worthless. The leaves are gathered when there is no dew or other moisture on them wilted for a few hours in the open, and then dried in an open shed until the stems will snap off short in the fingers They are then packed in burlap bags and shipped to market The price of native sumac varies from 90 cents to a dollar per hundred pounds in carload lots at shipping point

Palmetto extract is obtained from the roots of the cabbage palmetto (*Sabal palmetto*) which is very common on the sandy soils of the coast region of south eastern United States It makes a good substitute for gambier, is useful as a mordant in dyeing and according to Dumesny and Noyer (Wood Products Distillates and Extracts, London, 1908, page 278) "no other tannin agent is so well adapted for use in conjunction with chrome as palmetto extract" The authors speak very highly of the extract, for which they anticipate a great future, and give full instructions for its proper use Palmetto extract is little used at present though there are indications that the industry will be revived and extended When first introduced a great many difficulties combined to discourage its use, but it is claimed that these have since been entirely overcome as a result of laboratory researches and factory experience Canaigre is the name for the tuberous root of a species of *Rumex* growing in the Southwest where it was at one time more or less extensively cultivated Canaigre contains upward of 30 per cent of tannin The plant grows prolifically and the yield per acre under favorable conditions is high About 15 years ago it appeared that the industry would develop to enormous proportions but the freight charges for bringing the sliced dried roots from Texas and New Mexico to the tanners in the East were too high to allow a profit to the producers It is believed that this industry will be developed later

Oak bark has always held the highest place among our tannin substances and, in spite of its growing scarcity and the increasing use of other materials it still holds supremacy in the manufacture of the best grades of leather The bulk comes from two species the chestnut or rock oak (*Quercus prinus*) of the East and the tanbark oak (*Quercus densiflora*) of the West The tannin content of chestnut oak bark averages between 6 and 8 per cent, while that of tanbark oak runs as high as 29 per cent in some cases with an average two to three times that of the Eastern species There are in the South a number of oaks not now used for tannin which may offer possibilities for the future The tannin content of the bark of any of these species is high enough to be of commercial importance provided the raw material can be had in sufficient quantities The following table gives the results of some analyses showing the percentages based upon dry weights

	Black jack *Q marilandica*	Texas oak *Q texana*	Black oak *Q velutina*	White oak *Q alba*	Spanish oak *Q digitata*	Post oak *Q minor*
Per cent total solids	18 00	14 52	26 46	17 53	20 27	19 41
Per cent soluble solids	17 23	13 37	22 81	16 37	18 68	18 43
Per cent insolubles	77	1 15	1 65	1 16	1 59	98
Per cent non-tannins	6 51	7 44	9 36	7 09	7 62	8 05
Per cent tannin	10 73	5 93	13 45	9 28	11 06	10 38

The bark of the black or yellow oak (*Quercus velutina*) is now employed to some extent in the manufacture of what is known as quercitron bark extract The bark is steeped in hot water and the aqueous extract is concentrated in vacuum evaporating apparatus It is used for the dyeing of cotton, silk wool and fur, for the making of wall paper lakes printing inks, and boiler compounds and for tanning preliminary to dyeing In 1914, about 12 000 tons of

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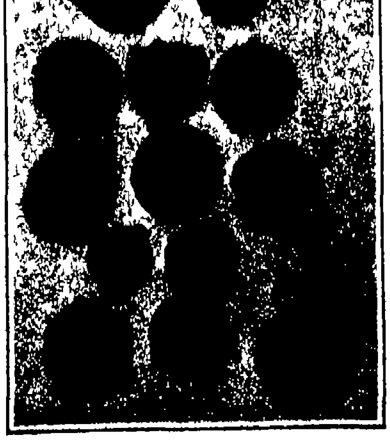
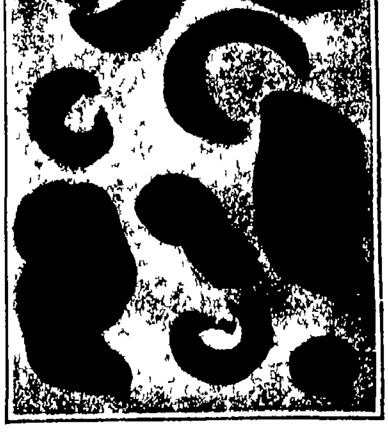
Myrobalan nuts, natural size



Aleppo galls, natural size

Gambier: dried extract from Singapore



Divi-divi seed pods, natural size

Government Transportation Plans

Great Work of the Society of Automobile Engineers in Standardizing Parts

By Coker F. Clarkson

It is scarcely possible to overestimate the practical value to the automobile industry of the standardization of parts which is being carried on by the Society of Automobile Engineers through its Conference Committee on Standard Specifications for Military Trucks. The following article is by Mr. Coker F. Clarkson, Secretary and General Manager of the S. A. E. and Chairman of the above-named Conference Committee.—EDITOR.

IN the great general plan for creating a sufficient national defense for the Government and people of the United States which is so rapidly seizing upon the common sense of the nation there will be encountered no more difficult or important problems than those having to do with the transport of troops in time of war. This broad question of transportation no longer means merely the passage of armies and supplies over railroads, but has to do with one of the most interesting and vital elements of modern warfare—the motor transport. Precisely as General Joffre is on high authority now believed to have saved the day for the Allies at the battle of Marne by his marvelously swift movement of a quarter of a million soldiers to the front from Paris in taxicabs and motor cars of every description so here in the United States, with its infinitely greater area does the automobile as a speedy, flexible and sure agency of transportation become a cardinal factor in all considerations of the national defense.

The Society of Automobile Engineers has grown to be recognized both here and abroad as the best expression of the mechanical and inventive genius of the vast American automobile industry. The work which this organization has done in standardizing materials used in this remarkable industry has in many cases been incorporated into international engineering practice, and it is now probable that the work will form the basis of establishing standard specifications for the purposes of the United States Army, particularly in the use of military trucks.

Toward this latter end representatives of the Society of Automobile Engineers have been closely in touch for the past few weeks with members of the War College in Washington with prominent railroad presidents, representing the American Railway Association and with the Industrial Preparedness Committee of the Naval Consulting Board of the United States. It now seems reasonable to state that out of this series of conferences the way has been paved to set on foot a closely knit workable organization for the handling of government transportation problems in time of war. The development of the plans has been greatly assisted by the Board of Directors and the General Manager of the National Automobile Chamber of Commerce, which has authorized its executives to meet the military authorities at every point in the building up of an adequate national motor transport service. This important organization has placed at the disposal of the government complete and accurate information concerning the manufacture and shipment of motor vehicles together with records of dealers organizations and up-to-date lists of trucks and pleasure car owners in all sections of the country. The American Automobile Association, with organizations in practically every state is the national body of owners of pleasure cars, and through it will be made possible the coördination of the volunteer movements which are being started in various parts of the United States.

For years the War College has been working on transportation plans to be effective in the event of war. The purpose of the recent conferences in Washington and New York with automobile and railroad representatives was to formulate a complete line of procedure as soon as possible. There were clearly set forth the limitations of the present provisions of the United States statutes and there was discussed such legislation now contemplated as that proposed to be enacted in the form of the Chamberlain Bill to provide for a motor truck reserve corps, the President appointing reserve corps officers subject to the orders of the War Department at any time in case of special emergency and for relatively short intervals in times of peace. It is thought that the motor truck corps will be under the jurisdiction of the Quartermaster's Department and the railroad transportation plans under the direction of the Engineer Corps of the Army.

It should, of course, be borne in mind that modern mobilization plans must be extremely elastic. The great war has taught that. No foreign nation has yet wholly abandoned animal transportation. In mobilization regulations current abroad at this time motor transport is divided broadly into two classes, consisting of heavy trucks and light trucks, respectively. By the use of 2,500 trucks 50 000 troops have been moved in what would have been thought, in past years, an incredibly short time.

The most recent meeting in connection with this movement, which very possibly may revolutionize the great scheme of transportation in this country, at least in time of war, marks the beginning of the establishment of comprehensive S A E. military standards. Once the fundamental requirements for the service in mind become clear, any additional detail recommendations necessary can be formulated with due promptness. The work is of a very broad nature, and must obviously be conducted carefully. The extremely hard conditions under which trucks operate at the front in time of war constitute a large study in themselves. The different divisions of the Standards Committee of the Society of Automobile Engineers will be assigned by the Society Council subjects within their jurisdiction and the scope of work extended as shall permit most thorough and effective deliberation.

President Russell Huff of the S A E expressed the view that in addition to the work of formulating ultimate standards the Society should through what might be called exigent committee work give all possible advice on specifications submitted to it. Accordingly, a committee was appointed recently to take up with the government officials detail data considered pertinent to standard specifications for gasoline motor trucks of 1½ tons capacity.

The automobile industry will appoint representatives to work on a national plan of military transport to be developed in detail. Ways and means must be had to form units of procurable machines and material. The automobile industry will in the last analysis have to supply the men to man the trucks as well as the trucks themselves. The number of trucks needed would depend on the length of haul rather than the number of men or the amount of supplies to be hauled. It is estimated that there is nearly 30 per cent saving operating trucks 30 miles a day as compared with horse haulage.

The good roads authorities are hopeful that with the existing methods of State aid in forty different states, and the proposed Federal aid there will be in a short time four or five roads across the United States in an east and west direction, and the same number north and south.

There is good assurance that an adequate military transportation system will be established and maintained in this country, inasmuch as the government officials and the civilian authorities are working sincerely with due strenuousness and effectiveness to this end.

It may be interesting to readers of the SCIENTIFIC AMERICAN to know something of the work of the scientific society which has been called upon by the Government for its advice and action. The Society of Automobile Engineers is now one of the great engineering bodies of the world. Its work is never concerned with yesterday but rather with to-morrow and the day after to-morrow, and its work is never ended. The automobile industry is developing so rapidly that constant investigation and research work are necessary not only to keep pace with it, but to stay almost in advance of the automobile building art.

The public is always more interested in accomplishment than in promise. A recent investigation among automobile manufacturers has shown that a large majority are using extensively standards established by the Society of Automobile Engineers. The S.A.E. screw and bolt standard, which has been specially developed to meet the needs of the automobile industry, is used by 94 per cent of the companies from whom reports were received. S.A.E. lock washers, consisting of 35 sizes instead of 300 or 400 sizes formerly used before the day of S.A.E., are now standard practice of 90 per cent of those from whom information was had.

Recent standards, the result of painstaking labor by the many different Divisions of the great Standards Committee of the Society, officially adopted by the organization as a whole and made available to the entire motor car industry, include a provision for the elimination of headlight glare, specifications for electric cable for gasoline automobiles, mileage and speed ratings for electric trucks, specifications for steel steering manufacture, purchase and methods of making chemical analysis and physical tests, standard sizes of license plates, standard location of engine and chassis numbers, rubber hose and hose fittings, and methods of testing leaf springs.

But the lay reader—the man in the motor car—may ask wherein does all this profit him. The answer is very simple through the steady reduction in price of cars accompanied by an equally steady increase in quality.

Even the manufacturers of engines for agricultural tractors are using S.A.E. standards as a basis for specifications. Thus in the future farmers of the country will benefit by work begun by the automobile engineers. Organizations of motor boat and aeroplane engineers are also planning to use S.A.E. standards as a foundation in their own standardization work, and the older organization is giving every assistance to these younger bodies.

As evidence of the quality of the personnel of the Society of Automobile Engineers it is interesting to note that three of its past-presidents have recently been called upon by the Government of the United States for the use of their talents. A. L. Riker is an active member of the Naval Consulting Board of the United States, Howard E. Coffin is Chairman of the now famous Committee on Industrial Preparedness of that Board, and Henry Souther, who in addition to being a past president was for several years Chairman of the Standards Committee which has done so much to bring the American automobile industry to its present development has just been appointed by Secretary of War Baker, consulting engineer to the United States Aviation Corps, to aid in the development of that branch of the armed forces of the Government.

The keen interest of the automobile engineer in the construction of the economically operated automobile is shown by the nature of recent meetings held by the local organizations, or sections, of the society. For example the Metropolitan Section held a largely attended meeting in New York at which the automobile fuel situation was considered in all its phases. The Cleveland Section of the society at its April meeting discussed recent developments in carburetion that are expected to have an important bearing in reducing fuel consumption and in permitting the use of cheaper fuels than are at present possible. The Indiana Section held a most enthusiastic meeting lately at which an entirely new method was described of converting the heat of the fuel into useful work.

These local meetings and the establishment of widely used standards are an expression of the value of the society's work both to the public and to its members. The society is continuously growing because it meets the demand for a coördinate body of the automobile industry, wherein technical matters can be authoritatively discussed, preferable engineering practice recommended, and friendship and fellowship fostered. The coöperation and interchange of knowledge resulting from the activities of the society benefit its members directly and through them everyone interested in any way, as user, dealer or maker, in the automobile industry.

Thus it will be seen that while the Society of Automobile Engineers owes its existence to the scientific and mechanical needs of the fourth American industry in point of size, its activities and achievements are in no sense solely academic and technical, but in their broad scope touch the life of the nation at many points.

Sewer Pipes from Hawaiian Molten Lava

THE making of sewer pipes and bricks of the molten lava from the active volcano Kilauea is advanced as a business proposition by a retired Ohio manufacturer of sewer pipes, who visited the Hawaiian Islands in February of the current year. The volcano is on the island of Hawaii, 32 miles from Hilo, and reached directly by automobile over a smooth road that dips down through a break in the wall of the old crater to the floor of dead lava and thence almost to the brink of the pit of Halemaumau.

It is declared that with proper machinery, pipes could be molded from the molten material in foundries. The plan has been advanced to erect endless bucket conveyors that could bear the lava out of the pit, the buckets to be made of a special material capable of withstanding heat up to 2,000 deg. Fahr. It is believed that the lava would remain liquid during the short time it would be on the way to the molds, which could be placed in a building near the edge of the crater.

For the past ten years a local brick company has been making building bricks from lava rocks. Its plant is located in the district of Kalihi, where there is a vast outcropping of lava rocks from ancient flows. These bricks are gray in color and have been used extensively in the construction of buildings and particularly in sewer, manhole, and fireplace work.

Front of new Massachusetts Institute of Technology Building, seen across Charles River from Boston

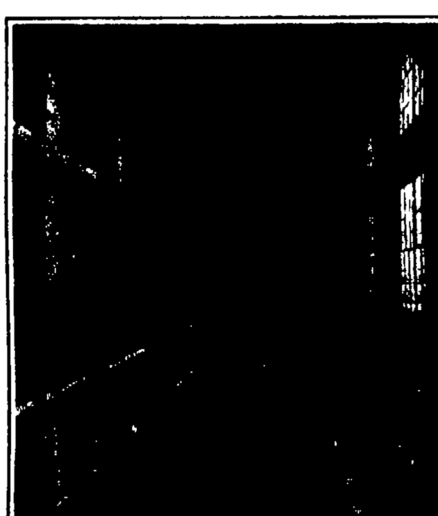
WE are accustomed to beholding in the mere physical aspect of a university—in its grounds and buildings—the evidences of small beginnings, of growth and development, of slow enlargement addition and extension On the typical campus the old mingles with the new, the first building put up by the original founders rubs elbows with the gift of the latest Decennial class, a few structures are still found adequate for their original purposes, others have been directed to entirely different ends In keeping its physical equipment in harmony with its changing scientific aims—with the changing aims of science itself, in fact—the University finds makeshift and compromise a vital necessity Three Schools of diminishing consequence are housed together in a building designed for one of them, and the School of the hour sprawls itself all over the campus seizing on vacant buildings and floors and rooms where it can find them

A new University, however richly endowed and elaborately planned cannot have the complete and well balanced scientific organization developed by years of experience An old one, on the other hand, is of necessity confronted by this problem of physical adjustment. The obvious middle ground is to take an old University and put it in new clothes, to let it outgrow its old physical body entirely and get a new one It has remained for the Massachusetts Institute of Technology, of Boston, to furnish the supreme example of a University thus made to order

For years this institution has been badly crowded in its old home in Boston, and the impossibility of getting land for expansion led to a solution of the problem by transplanting the entire University to a new site, across the river in Cambridge The plans call for a complete home, with residential halls and a social center, as well as facilities for conducting studies, but the Educational Group is the first and by far the largest step towards realizing the dreams of the thousands of friends and alumni of this famous institution of learning The New Technology will be dedicated with the completion of this group on June 12 14, after nearly two years and a half of construction, and a host of alumni, many of them national figures in business and the sciences, with invited guests prominent in all walks, will attend a great three-days' celebration on the beautiful site facing the Charles River Basin, Boston's unique water park

There are twelve connected buildings in this Educational Group arranged along three sides of a broad and deep central court flanked by two side courts of only less magnitude Around these courts are ranged the class-rooms, lecture rooms and laboratories. Few structures built for any purpose exceed this group in magnitude of constructional work. Six thousand carloads of material were handled, which would make a train reaching from New York to Albany—a distance of 150 miles. This material was moved by means of a temporary railroad surrounding the buildings and served by locomotive cranes as well as locomotives. The concrete and masonry used totaled 80,000 cubic yards, enough to make a solid shaft the height of the Woolworth Building, with square section, and filling Broadway from curb to curb, and an approximate amount of sand and gravel was employed

The best part of the work of M I T is done in the laboratories, and these have been planned in the new buildings with the greatest care and attention to detail The steam laboratory in the Mechanical Engineering Building receives high pressure steam through two mains located below the ceiling of the first floor A superheater may be connected at will with the machines where experiments are to be made The condensers of the various engines in the steam laboratory



Hydraulic laboratory, showing 10-ton crane

are in the basement and take cooling water from one of the large canals of the hydraulic equipment passing the used water into a hot water return Apparatus for determining the flow of superheated steam through orifices or turbine nozzles will also be located in the basement.

The Institute has conducted a modest aerodynamic laboratory for many years and for six or eight years has paid special attention to fundamental principles of aircraft construction The up-to-date aerodynamic equipment of the new buildings includes a 4 foot blowing tunnel, in which velocities may reach 40 miles an hour A 7 foot fan sucks the air through the tunnel, in the center of which, where the air currents are most regular and steady, are arrangements for placing the various devices to be tested Perhaps the most novel feature of the equipment is the aerodynamical balance, an instrument for measuring components in any one of three directions This instrument, of English model, measures wind pressures the twist due to inequalities of pressure, and the lift, and is adaptable to all kinds of surfaces Thus the effect of wind on planes may be determined, or on propellers or even different forms of sails

The electrical laboratories maintained by coöperation between Harvard and Massachusetts Institute of Technology, will contain the finest collection of artificial electric conduction lines in the world There will be a 2 000 nautical mile artificial submarine cable corresponding to a regular ocean telegraphic cable a 2,500 mile, long distance, aerial line corresponding to a transcontinental telephone line, two artificial power transmission lines of 800 miles, an artificial telephone subterranean line of 35 miles, and a number of other special transmission lines of unusual types. In addition to these, there is a transmission span, the gift of Stone & Webster, a replica of the Big Creek 150 000 volt power transmission line in California This has been in place for a year or more and is used for testing in a variety of ways, such as the effect on sag of temperature and the relations of soil surface to electrical ground for which there are no formulæ existing For these tests a local laboratory has been installed at the foot of one of the towers Experiments are also conducted, using the wires of the span or antennæ.

The design of the hydraulic laboratory, containing some 700 feet of waterway has received study from many prominent hydraulic engineers and is constructed throughout with a view to enabling the most precise experiments in flowage and hydraulic work Water is supplied from the concrete intake connecting with the Charles River Basin, and flows into large circulating canals in the basement of the building from which it is pumped through a venturi tube into an open steel flume located on the second floor From this flume it flows through a steel penstock provided with openings for water wheels A concrete draft tube connects with the lower end of the penstock, and from this draft tube the water discharges through sluice gates or over weirs back into the circulating canal The capacity of the system including the circulating canals and the adjoining steam laboratory, is 250 000 gallons

The equipment includes many pumps and tanks. A belt-driven rotary pump of a thousand gallons a minute capacity will be used in connection with a steel pressure tank 5 feet in diameter and 32 feet high, built for a pressure of 250 pounds to the inch An artificial head of 575 feet is established in this device by means of compressed air forced into the top of the tank. Flow through orifices is always an important part of hydraulic study and this is naturally affected by any currents within the tank that come near the ori-

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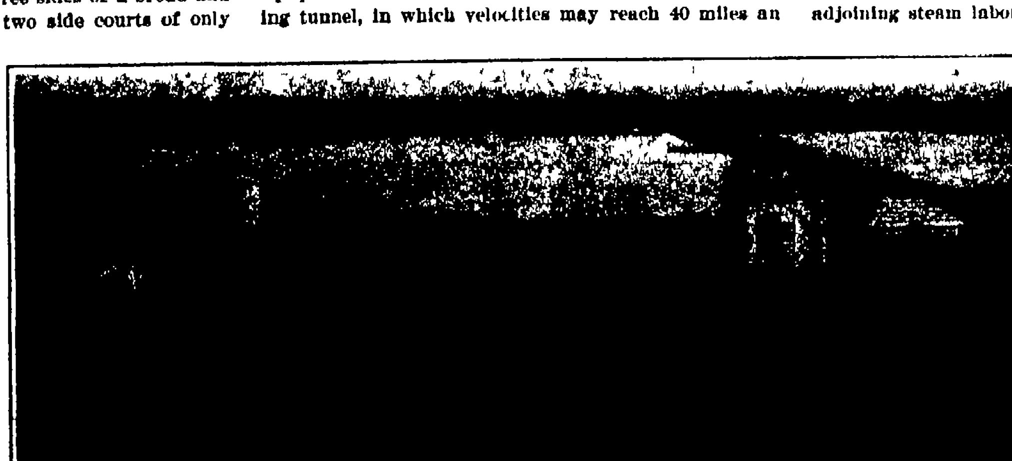


Looking across the unfinished campus toward Boston

Plain Facts About Kerosene Carburetors

Of Paramount Interest in the Face of the Serious Gasoline Situation

By Victor W Pagé, M.S.A E.

THE rapidly increasing use of internal combustion engines in all types of self propelled vehicles and in motor boats, as well as in the numerous stationary power applications, has resulted in a scarcity of gasoline which has not been a serious factor to consider until this year. As a result of the increasing price, numerous suggestions have been made that kerosene be used as a substitute fuel. A number of devices are offered for vaporizing kerosene and many claims are *made by the promoters for these that are not always* thoroughly borne out in practice. While kerosene is fairly plentiful its physical properties are such as to render it a poor substitute for gasoline with existing carburetors and engine design.

The main drawback is that kerosene is much less volatile than gasoline and must be raised above atmospheric temperature before it will vaporize readily. This lack of the property of quick evaporation, which has been the greatest advantage of gasoline, not only interferes with rapid volatilization but makes kerosene a "smelly" fuel to handle.

Kerosene however has marked advantages which will appeal to the user of internal combustion engines more when entirely suitable devices are evolved for gasifying it successfully. The big advantage at the present time is the relative cheapness, the cost being somewhat less than one half the present wholesale price of gasoline. At the present time the fuel cost of the average small car may be taken as one cent per mile though if the less volatile fuel could be used the cost would be but 0.4 cent per mile. Owing to the greater number of heat units in kerosene, about 5 per cent increase in power would be *secured from the same* quantity though this is conditioned by securing practically complete vaporization. Owing to the lubricating power possessed by kerosene less lubricating oil will be required. It is very likely that heavier oil will be needed in an engine using kerosene than in one using gasoline on account of the dilution and consequent thinning of the oil in the crank case by the kerosene which will condense from the vapor in the engine cylinders and work down by the piston rings every time the engine is stopped and allowed to become cool. As kerosene carbon is drier and somewhat finer than the residue left after gasoline is burnt there should be less spark plug trouble and the cylinders can be cleaned easier. If the carburetion of kerosene is successfully accomplished a slightly greater mileage per unit of *measurement* will be secured than with gasoline.

Considering at the present time its use in automobile engines because it has been successfully applied in stationary and marine power plants one great disadvantage is that it is not possible to start the ordinary gasoline engine "cold" with kerosene. Therefore the most successful kerosene carburetors are really bi-fuel in that gasoline may be used for a preliminary run to warm up the engine and the vaporizing chamber and then turned off and the kerosene vapor allowed to go to the hot engine. Another disadvantage is that the compression of the ordinary gasoline engine must be reduced in order to use kerosene vapor. After the engine has run a while, providing that the compression is over 40 to 45 pounds, a pronounced pounding will result which is due to preignition of the vapor. In order to use the normal compression of 65 to 70 pounds, the cooling system must be greatly increased in efficiency or water must be injected with the gas charge. Another difficulty is smoky exhaust if the mixture of kerosene and air is not carefully proportioned.

With most kerosene carburetors that the writer has tried—one series of tests made for a prominent metropolitan taxicab company furnished the opportunity of trying a number of the most successful devices—it was very difficult to proportion the mixture so that any degree of flexibility of engine action could be secured without having a grayish smoke issue from the exhaust. This had a disagreeable odor of kerosene, which showed that some excess of fuel was required to have an engine that would be at all responsive to throttle control. In no case where kerosene was used could an engine be throttled down to run as slowly as with gasoline, though with certain carburetor settings it was possible to run *the engine as fast*, with kerosene, *except for a few* revolutions beyond the peak of the power curve, as it was with gasoline. The time required to heat up the engine so kerosene can be used must, of course, depend on a number of variables which will differ in every individual design. With carburetors where the exhaust gas heated chamber was of liberal proportions, it was found possible to turn on the kerosene after the engine had been running for several minutes. After the engine had become heated up it was possible to start it on kerosene vapor after it was stopped, without requiring the use of the auxiliary gasoline vaporizer. In one case the automobile engine with which the trials were made was started on kerosene 15 minutes after it had stopped. A stop of greater length than this necessitated the use of a gasoline carburetor or the gasoline section of the kerosene carburetor to secure a reasonably quick start.

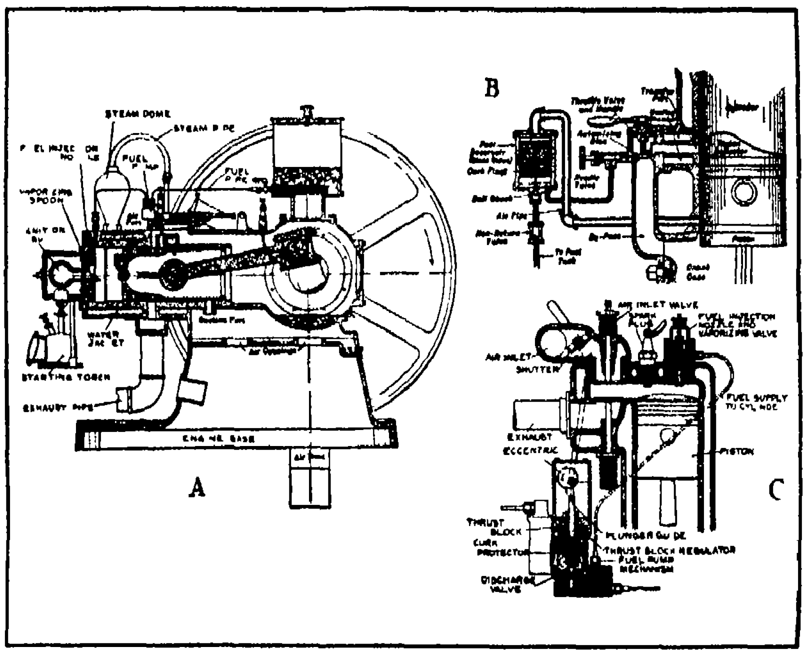


Fig 1.—Forms of engines designed to use kerosene fuel by injecting it into the cylinder under pressure

It does not seem to the writer that, in the limited space available, any extended review of the characteristics of the various fuels is justified. Data of this kind, which is purely technical in nature, does not as a rule interest the majority of readers, and those who are sufficiently versed technically to feel the need of this information have many authoritative and readily accessible sources from which they can obtain it. It does seem, however, that a brief exposition of the various systems of using kerosene as an internal combustion fuel will be of interest.

The engine shown in part section at Fig. 1-A outlines one of the earliest methods of using kerosene and other oils that are less volatile than gasoline. The engine is a two-stroke form and is an unconventional design in some respects. This type of construction is not suitable *for engines* that are to attain high speed or be of light weight, but was intended primarily for stationary power plants designed to run at a constant speed. Ignition was by a heated bulb which forms a continuation of the combustion chamber. The fuel is injected into the hot cylinder head through a special fitting, just before the piston reaches the top of its stroke, and as the fuel strikes the hot vaporizing spoon which projects into the combustion chamber it is vaporized because of the intense heat of the relatively thin metal section of that part. The portion of the vapor forced into the ignition bulb just before the piston reaches the end of its up stroke is ignited because of the heat of that part. The resulting combustion ignites the remainder of the charge and exerts the desired pressure on the piston top. The kerosene is injected by the pressure produced by a small oil pump of the plunger type. To start the engine, heat is applied to the ignition bulb by means of a gasoline or alcohol torch.

In view of the present often repeated suggestions that water vapor be used to assist in securing proper combustion of the kerosene vapor, it is interesting to see that this feature was recognized on the type of engine illustrated which was designed fully 20 years ago. A steam dome was attached to the water jacket, and as the cooling water became hot enough to evolve steam, this collected in the dome and was forced into the air port where the moisture mixed with the air stream coming from the crank case and passed through the air port into the cylinder.

A more recently devised scheme for injecting kerosene vapor into a two stroke engine is shown at Fig 1 B. This system has been used on small marine motors, as well as stationary farm engines. With this device the liquid is converted into a fine mist before it enters the cylinder. A fuel reservoir, carrying a cork float is connected to the main fuel tank with one of the pipes at the bottom and with the needle valve of the atomizer by the other small pipe. A larger pipe connects the top of the fuel reservoir with a small port in the cylinder walls just above the by pass leading from the crank case to the atomizer device. The chamber leading to the cylinder is surrounded by the water jacket which keeps the short passage leading from the atomizer to the transfer port hot. Carburetion is effected by a combination of mechanical atomization and the vaporizing influence of heat. The engine operates on the well known two-stroke principle. Just before the transfer port is opened by the piston on its downward stroke the air pressure in the crank case passes through the air pipe and against the top of the float chamber, producing a pressure therein which forces the liquid fuel through the opening in the seat of the atomizing disk. This disk is lifted by the air flow from the crank case when the piston uncovers the transfer port. This air has been drawn into the crank-case through a suitable valve in the engine base which opened when the piston was on its up-stroke. The air stream rushing past the atomizing disk picks up the fuel vapor forced in from the reservoir and as this mixture of air and vapor is directed to the top of the cylinder it must pass the heated deflector member at the top of the piston. This produces practical evaporation of the kerosene mist and the resulting gas is easily ignited by the usual form of spark plug. Inasmuch as

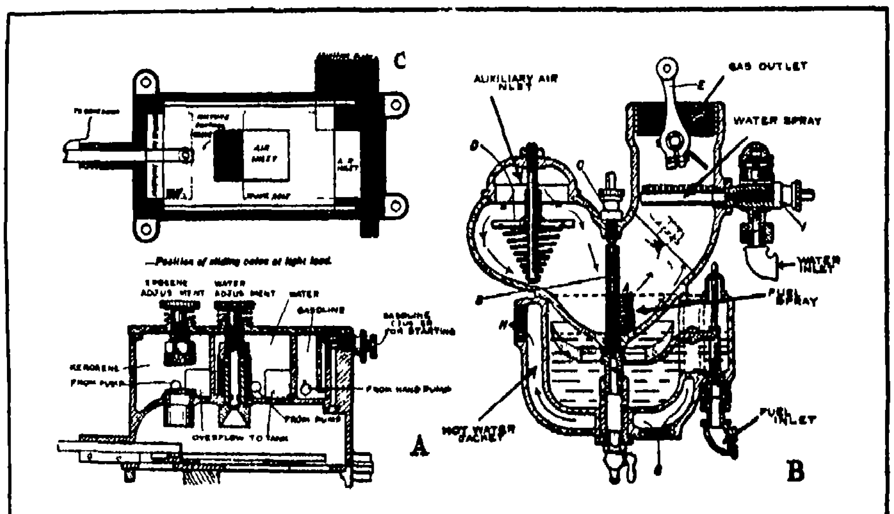


Fig. 2.—Kerosene vaporizers in which water spray is mixed with gas

a certain amount of time is needed to secure thorough vaporization, it is not possible to run this engine at a high rate of speed though some degree of speed control is secured by the throttle valve mounted just above the atomizing disk which controls the area of the by-pass.

The engine shown at Fig 1-C is a four-stroke design of French derivation and is known as the Bellem and Brégéras. This has been devised especially for automobile use, and one of its characteristics is that it can use, without preheating, the less volatile fuels and can start cold on ordinary kerosene. In order to secure this important feature the inventors inject and atomize the fuel under very strong suction. At each induction stroke a definite amount of liquid is carried by a pump into a special atomizing valve which opens only after the piston has accomplished a certain part of its induction stroke, thus creating a considerable vacuum inside the cylinder Immediately after this carbureted air is admitted, the remainder of the cylinder volume is filled with pure air through a second admission valve

Speed regulation is obtained by a variable speed feed pump This is a reciprocating type of the usual plunger construction in which that member is worked by a connecting rod and eccentric. The cylinder is not fixed to any part but is centered about the piston in the usual manner No packing glands are employed but a cork protector which produces considerable friction between the cylinder and piston is used instead If the cylinder were not limited in its movement it would move up and down with the piston without any pumping action resulting Two thrust blocks limit the motion of the cylinder which movement must be deducted from the effective stroke of the pump By varying the distance between the thrust blocks one can alter the difference in motion between the cylinder and plunger and of course regulate the effective stroke and output of the fuel pump The regulation of speed is effected by changing the distance between the thrust blocks. A throttle in the air pipe through which air is admitted on the suction stroke is interconnected with a regulating device which governs the upper thrust block. The pump takes in air at the bottom of its stroke and the fuel delivery occurs when a valve is lifted off its seat by the cylinder It will be apparent that a rather complicated injection nozzle or vaporizing valve must be used in the cylinder head and that the oil pump mechanism is not free from complication either The resulting number of small parts which are likely to get out of order will not be welcomed by the average motorist. It does not seem that a system of this nature could be used successfully by the average automobile operator because of its complication

Owing to the large size of tractor engines, the power plants of a number of agricultural tractors are arranged so that kerosene, distillate and similar low grade oils may be burned successfully The device shown at *A*, Fig 2, is the carburetor which operates on what is known as the Secor-Higgins system This is not a new method by any means because it was developed over 15 years ago. The device provides an automatic variation in the quantity of fuel mixture in accordance with the variation in speed and load of the engine, in conjunction with a degree of compression depending upon the quantity of mixture inhaled The main feature is the automatic control of the internal temperature through the admission of water as part of the fuel mixture. It is claimed that controlling the temperature of vaporization and combustion in this manner means that there is no ' cracking ' of the low grade oil, with its attendant carbon deposit The injection of water also permits the use of higher compression and reduces the pounding which is found in many kerosene engines It is also said to give an increase in power of 10 to 15 per cent over a similar engine and carburetor operating without it

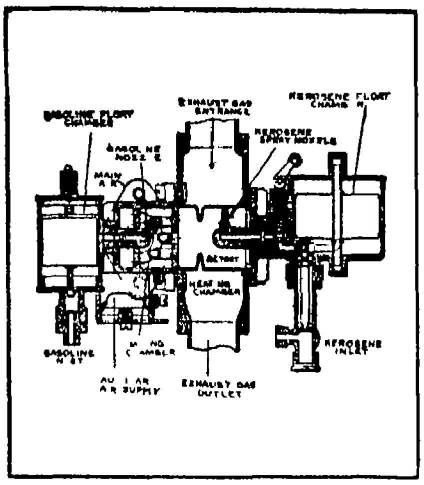


Fig 3 —Early form of bi-fuel carburetor

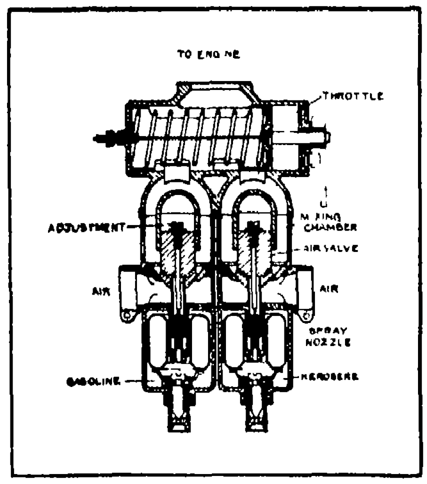


Fig 4 —The Belsize bi-fuel carburetor

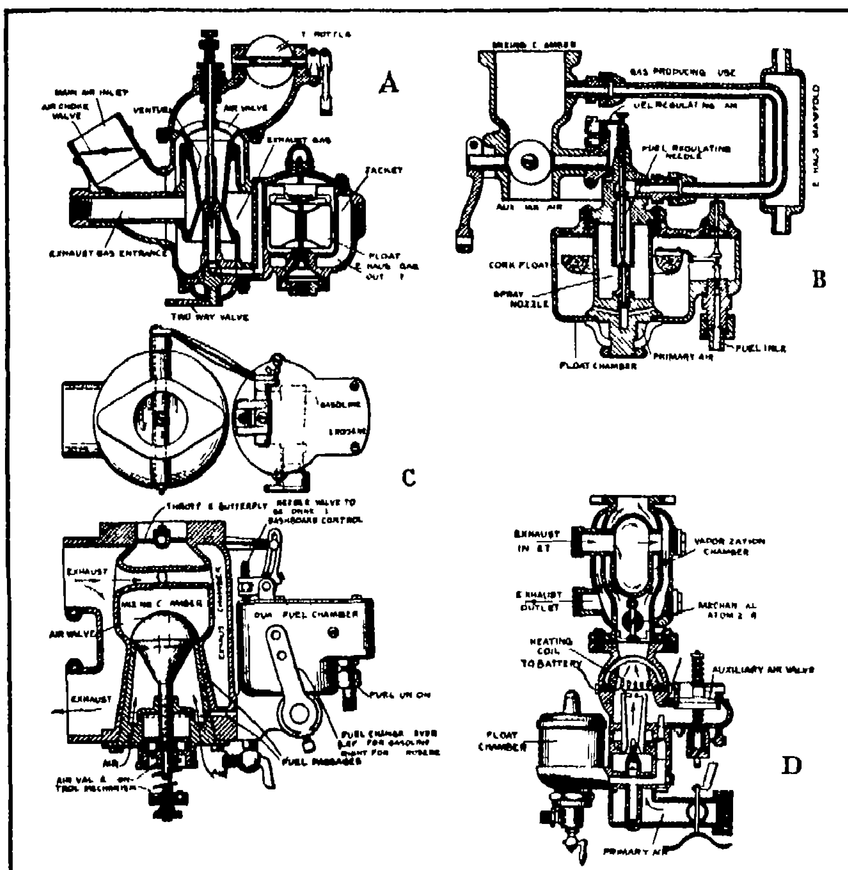


Fig. 5 —Group of kerosene carburetors in which the mixing chamber is heated to vaporize the fuel and raise the temperature of the gas and air mixture

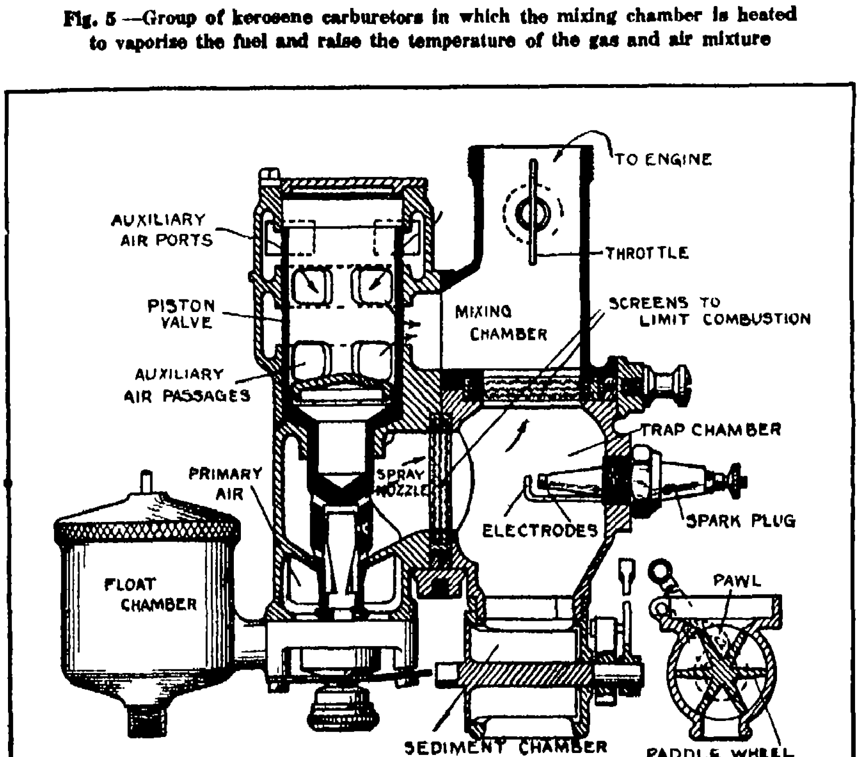


Fig. 6.—Kerosene carburetor in which a partial combustion takes place in a trap chamber to secure vaporization of the fuel

The feature of the device is that the water is not only controlled in amount but is taken into the engine automatically As the load increases the throttle opens because of the governor action and more air is inspired through the carburetor It is not until about half load is reached that the suction becomes strong enough to lift the water hence it is not present to hinder ignition at light load The special carburetor which makes possible the application of this system is clearly illustrated A flyball governor (not shown) operates a sliding brass valve, known as the mixture control valve and clearly outlined The carburetor is placed above the cylinders having a very short inlet manifold so there is little opportunity for the liquid to condense from the mixture on its way to the combustion chamber The device contains constant level chambers for kerosene and water both chambers being supplied by power pumps and having overflows to return the excess to the tank A similar chamber which may be filled with a hand pump is used to hold gasoline for starting The kerosene supply is regulated by a needle valve and a similar method of regulation is provided for the water and the gasoline An air inlet is regulated by an adjusting plate and the only moving part in the carburetor is the sliding plate worked by the speed governor The adjusting plate is to permit of the carburetor being adjusted to the specific engine it is to serve and this need not be changed unless the engine enters a different altitude While this device works out very well on tractor engines it does not permit the variation in speed or the quick pick up that is so essential in automobile engine operation

The carburetor shown at Fig 2 B is a conventional float feed type designed to use kerosene vapor This also has water spray injection with the mixture in order to secure thorough combustion It will be noticed that the float bowl is provided with a jacket through which hot water circulates This heats the kerosene and makes it vaporize more readily The operation of this device does not differ from the conventional gasoline carburetors as it is very similar in construction, except for the interposition of the water spray in the mixing chamber This type of carburetor provides for thorough atomization by drawing the fuel through small holes in the standpipe as the suction increases the fuel rises higher in the standpipe and is drawn through a greater number of holes The auxiliary air valve is of the flat seated type and is normally held seated by a coil spring As is true of gasoline carburetors, the spring tension may be altered to regulate air valve movement The kerosene spray nozzle is regulated by a needle valve as is also true of the water supply With the device shown an independent gasoline atomizer is needed to start the engine though this is shut off as soon as the engine becomes hot enough to operate on kerosene

It was but natural for early inventors who sought to use kerosene to evolve a type of carburetor that was really a dual instrument and that was provided with independent gasoline and kerosene float chambers The device shown at Fig 3 was invented fully 15 years ago and is known as the Claudel carburetor It will be observed that there is a gasoline float chamber on one side and

(*Concluded on page 607*)

Our New Industries

Some of the Fields Into Which American Manufacturers Have Been Forced

By Dr Edward Ewing Pratt, Chief of the Bureau of Foreign and Domestic Commerce

EVERY American I suppose is familiar with the fact that the war has had a tremendous influence on our industrial life, and of the factors that go to make up our *present material prosperity the most evi*dent are undoubtedly the sudden expansion of the iron and steel industry the giant strides made in the man ufacture of munitions, and the record crops of cereals and the high prices paid for them Some lines have benefited from war zone demands while others have benefited from the war zone's inability to supply Amer ican demands This article is concerned with the lat ter—with the new industries that have sprung up to supply goods that were formerly supplied by Europe and the old industries that have been greatly expanded to meet the demands for such goods

These new industries have resulted either because certain lines of goods formerly received from the Cen tral Powers and Belgium have been cut off altogether or because accustomed supplies from the allied coun tries have been greatly reduced by the lack of ships In either case Americans are learning to manufacture goods that were formerly bought abroad and this ex perience will undoubtedly, in the long run, be of more real benefit to the country than the temporary muni tions business

Our principal purchases from Germany in the order of their value, have been hides and furs, cotton manu factures, dyes and chemicals, machinery and other manufactures of iron and steel, potash, pottery, silk and silk manufactures, toys, glacé leather and glacé leather gloves, rubber, pa per and paper manufac tures, and salt. Of these classes there are several of which Germany has had a practical monopoly—such as dyes and certain chem icals, potash, and toys—and the effect of cutting off some of these was imme diate and serious The prin cipal problems we have now before us are the more com plete utilization of the coal tar obtained in the coking industry and a method of manufacturing potash from one or more of our potash bearing materials

Necessity has forced us to make rapid progress in the chemistry of coal tars and although the demands of the munitions manufactur ers have interfered with the development of the dyestuff industry and the many minor branches that depend upon coal tar, the progress made by our dye makers has exceeded the expecta tions of all well informed persons The recovery of coal tar "crudes" from the coke-oven by products has now been so developed that the output is more than sufficient to cover the needs of a national color indus try Two years ago the annual output of "crudes," i e, benzol, toluol, naphthaline and phenol, was about 14,375 tons To day the estimated output is at the rate of 135 000 tons a year

Some 33 companies are now occupied with the manu facture of coal tar intermediates The leading produc tion is aniline, of which the output for 1916 will ex ceed 15 000 tons Over 3,000 tons of the other inter mediates are produced by the same companies Large additional amounts are made in the works of com panies directly engaged in manufacturing colors and making their own intermediates

The number of companies manufacturing finished dyes has increased from 6 in 1914 to 24 in 1916, al though it should be borne in mind that some of these are small companies devoted largely to experimental work Finished dyes are now being produced at the rate of 15 000 tons annually Increased facilities for producing direct blacks and sulphur blacks are re sponsible in large measure for this expansion of our dyestuff industry, as it has been necessary to meet the most pressing needs of color users first. There has, however been a regular production of other colors, especially of blues and steps are being taken to in crease the extent and variety of this output.

Moreover, the growth of the natural dyestuff indus try as a result of the color shortage has been very interesting The Bureau of Census reports a domestic *output of such dyes of* $1,860,000 in 1914, an increase of 32 per cent as compared to 1909 At the start of the war American extract works were fortunately in a position to expand rapidly and were handicapped only by the difficulty in getting raw material from the West Indies and elsewhere as quickly as it was wanted The principal increase has been in logwood extract, quercitron fustic, cutch and archil At the same time the *production of osage-orange extract on a commer* cial scale has been established, and this material is now available for the tanning, textile, paper, and other industries It is being used successfully in dyeing pa per The study of osage-orange as a dyewood was be gun by the United States Forest Service about three and a half years ago, and was the result of an investi gation of the utilization of the mill waste of this west ern wood

It is not at all likely that natural dyestuffs will ever again be discarded to the extent they had been before the war started They have certain distinct advantages that will not be forgotten and the dyers have been able to produce a number of combinations effectively and economically with the natural materials The pres ent situation has rendered a valuable service in bring ing home to our manufacturers the value of natural dyestuffs and in broadening the dyer's trade.

Unhairing sealskins. A new industry established in St Louis

Carbolic acid is a coal tar product that formerly came almost exclusively from Germany, and it was one of the products that we could not get along without American ingenuity soon found a way to make it, as most readers of the SCIENTIFIC AMERICAN know, and there is now a sufficient supply for most needs, al though the price is still high If we are to work out a satisfactory system of using our coal tar we must give considerable attention to carbolic acid With the greatly increased production of coal tar it should be possible to manufacture it at a cost that would make foreign competition impossible

There are a great many other derivatives of coal tar that were made almost exclusively in Germany before the war and which we shall have to manufacture if our coal tar industry is to be a well balanced one Many of these derivatives are used medicinally, such as acetanilid and aspirin, and have been greatly missed since the war started. Others are used as developers in photography and only recently a warning has been issued that these should be used as sparingly as pos sible Some progress has been made in manufacturing hydroquinone, probably the most popular developer, and other coal tar photographic chemicals at home, and with the incentive of the present high prices there will be a continued increase in production during the com ing year Salicylic acid will soon be made in large quantities in works going up near New York. Sac charin is another German coal tar product now being made here in small quantities, although the price is up about 600 per cent. Coal tar creosote, so largely used in preserving lumber, is also being supplied in increased quantities. Even some beechwood creosote is being refined on a small scale by some chemical concerns. Benzoic acid, largely used as a preservative and antiseptic, is being manufactured from toluol.

But the effects of the war upon the coal tar industry are more or less familiar to every one. The topic has been touched on here only because of its transcending importance We have been taught the value of the industry and I hope we will show how much we appre ciate the lesson by mastering the difficult problems connected with it and keeping the business here at home There is no use of minimizing the difficulties that lie in the way of bringing our technical efficiency to the point required to make a success of the coal tar business It will take time and it will take painstaking effort, but it can be done It must be done We must learn how to utilize all the by products to the best advantage and how to find markets for the finished products. The war has expanded our production of coal tar crudes to supply the demand for explosives, and it is necessary that this factor in preparedness be not lost to us. We must develop the other branches of the industry to keep these plants running during peace.

Next to the coal tar products, potash is the most important of the articles Germany is no longer able to furnish us The natural German deposits can be worked so cheaply that in the past there has been very little incentive to recover the material from kelp, alunite, or other sources, but when the supplies from overseas were cut off there began an eager searching of our own resources. Consid erable potash has been se cured in various parts of the country as a primary product from kelp, alunite, the brine of certain alka line lakes, tobacco stems, and mica deposits, and as a by product in the manu facture of Portland cement and distillery waste But owing to the high prices, most of this has been used in industrial processes rath er than on the soil Potash as a fertilizer is about as scare now as at any time since the war started.

One other American in dustry has been greatly stimulated by the blockade of German ports—the man ufacture of dolls and toys. The rush to get into the toy business when the war broke had some aspects almost as comic as the most comic of the funny toys, and I suppose there are now some sadder and wiser citizens as the result. A num ber of good solid companies have made a fine start, however, and many of the older companies are estab lished on a scale they never dreamed of before. There is one novelty company in New York occupying all of a five-story building that was not in existence a year ago and there are dozens of other instances of firms that have grown too large for their old quarters I have talked to a number of the successful manufac turers, and their opinion seems to be that the most promising field is the manufacture of typical American toys These are being brought to a high degree of per fection and, even more important, into a high degree of public favor Once these toys are firmly established it will be difficult to sell Continental toys and dolls in this market again on any large scale Some success has been achieved also in making imitations of the products formerly purchased abroad, and doubtless some of this business will be retained permanently I have had called to my attention some of the patents recently asked for on American toys. Some, of course, are preposterous, but a great many excellent ideas have been patented, and this is one of the most hopeful signs in the toy trade. With all our American ingenu ity, there should be very little room here in the future

(Concluded on page 590)

War Game—XII

Strategical Plan of a Campaign and Its Tactical Details

By Lieut Guido von Horvath

[This is the last of the Scientific American War Games or map problems They began with the issue of March 11th, in which a very simple problem was dealt with. Successive numbers have had to do with increasingly complicated movement of troops and now the series is terminated with the strategical plan of a campaign and its tactical details The articles have been written particularly for laymen. We hope that they have been found profitable and instructive— Editor.]

THE preceding series has shown and illustrated that to make a War Plan and to work it out in all its details, the enemy must first be considered

It would be a great mistake to think that a strategical campaign can be planned ahead for its entire course, or that a general staff can develop a plan for an entire war which will contain every development from beginning to end. The Game of War, some features of which have been shown in the problems we have introduced, appears much like a growth, a steadily changing chain of events, where every action influences the next. The plans of a war are the results of an evolution along a predetermined line.

What, then, is meant in speaking of a War Plan?

It is not so much a War Plan as it is a plan to lead the forces of a nation to a successful conclusion of a war It can be best expressed by a word much in evidence just at present "Preparedness."

The logic of war is the logic of life in general.

In business, every plan of operations which involves two parties is based upon the same principles upon which war is conducted In each plan of operations, both in business and in war, the will of one contender is pitted against the other

The salesman, when he approaches a customer for the first time, in an effort to sell some meritorious product, is in a way a general It depends upon the strategy and tactics which he employs whether or not a sale is to be made There are a thousand and one plans for selling goods, plans which have been made by experts in their line, yet, from all these plans, there is not a single plan which will fit every case. One salesman will win his battle by aggressive tactics, another, by a slow, wearing-down strategy, another, by a swift assault against the prospective buyer's weak spot. Still another will win through sheer luck.

These are all features in the game of generalship.

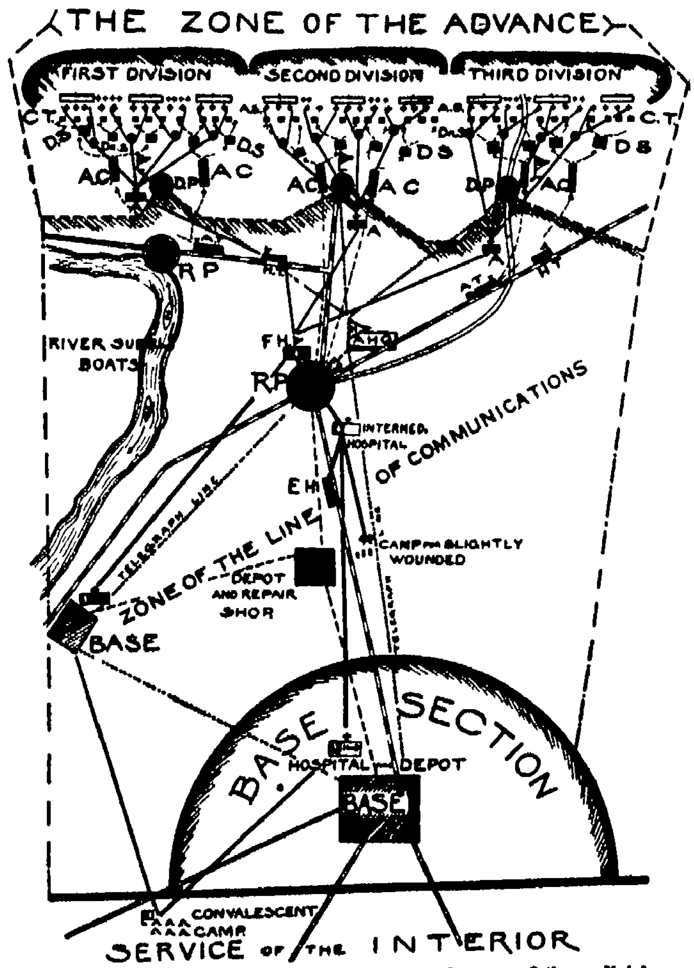
We do not mean to assert that a good salesman would make a good general, any more than that a good general would be successful as a salesman. We mean that in business life as well as in war, success will come to him who is thoroughly prepared in the line of endeavor which he selects.

This all means that plans must be prepared, not for the whole campaign, but for its successful beginning Such plans must be on a large scale. They must provide first of all for the successful mobilization of all forces and war material, and their speedy and well timed transportation to points of strategical importance.

No one can foretell the outcome of a combat. This is the reason why far reaching and skillfully planned campaigns would fail, simply because a combat is the unknown quantity in the mathematics of strategy But, while in the mathematics an exact result can be produced from an equation, in strategy the unknown quantity will overthrow the known elements involved.

In modern war, every great combat is either the result of pre-arranged plans of the highest commander, or the outcome of independent action taken by the commanders of subordinate parts of the army However this might have been is of no consequence; the important point is that every such combat will effect a decided change in the strategical situation.

This change, therefore, must be considered, either by fully pressing home the victory or by reducing and avoiding a defeat at the hands of the enemy



Outline of the administrative service of a field army of three divisions

Ammunition Service:

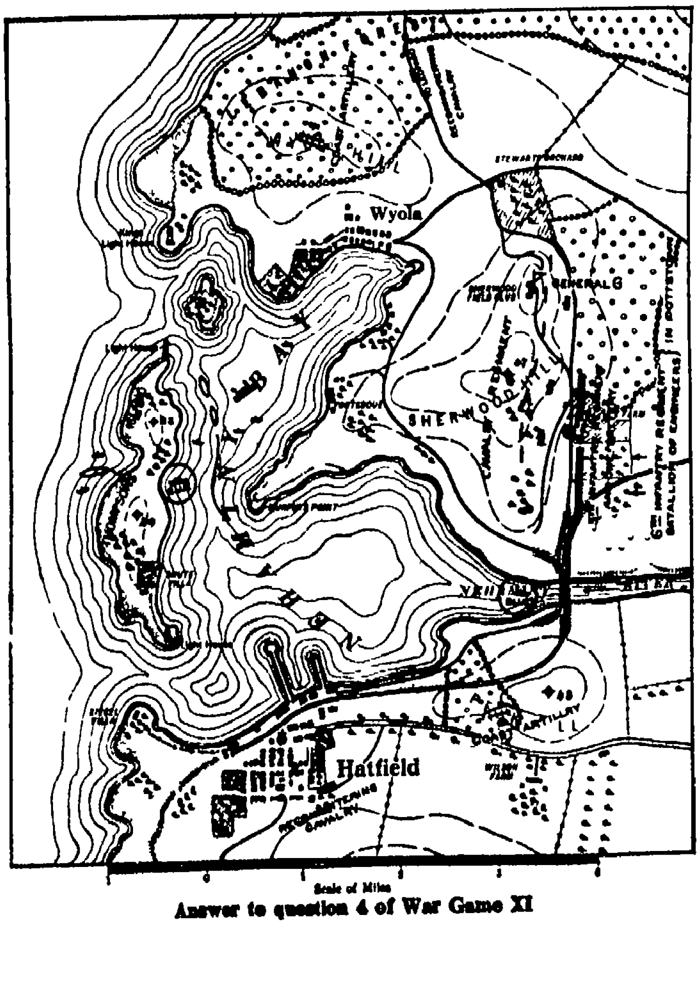
C T Combat train
D S. Distributing Station
A Ammunition Company
A C Ammunition Column
R P Refilling Point.

Sanitary Service:

A S. Aid Station
D S Dressing Station
A. C Ambulance Company
F. H. Field Hospital.
H T Hospital Train
E. H Evacuation Hospital

Telegraph and Signal Service

A H Q. Army Headquarters.
D H Division Headquarters.
Black lines for Sanitary Service Light broken lines Ammunition Supply Service Heavy broken lines, Telegraph and Signal Service.



Answer to question 4 of War Game XI

Hence all the developments resulting from the tactical changes create new situations with which the commander must cope And this state of affairs will continue till the end of the war It is as Field Marshal von Moltke has often said "A system of remedying"

There is one exception to the above statements, but an exception which strengthens the rule This is in a case where the original intentions are directed toward evading a vital issue, where the aim of the general staff is to remain on the defensive, to never run the risk of a decisive combat, and to fight with the intention of establishing a balance before their own forces are ready to enter the offensive and decisive

Considering the lack of preparedness this sort of strategy would be of great importance as far as our own country is concerned That such plans can be made successfully and can be realized was shown in the 1914 and 1915 campaign of Germany and Austria Hungary against the tremendously overwhelming forces of Russia

Quite naturally, this means of securing victory is a costly undertaking It might demand the yielding of much territory and the enemy will occupy this land and derive all kinds of material benefits from it Nevertheless, where there are no other means, strategy is not particular

It will now be clear that the possibility of making such plan rests on the fundamental fact that decisive engagements are left out of consideration

The most important question to decide upon in a war plan is whether it shall be an aggressive campaign or one of defensive nature. In the first case the main consideration must be the direction of the attack, in the second, how far the giving way should go and when should the counter action begin.

Beside purely military questions, very often the political situation must be considered To meet this situation and to bring the two into harmony demands the highest understanding and a deep insight into prevailing circumstances.

In a democratic country, where the peaceful citizens abhor conscription and compulsory military service, an invasion by any enemy would call forth the greatest patriotism and the citizens would rally around the flag With the full realization of the common danger, the spirit of patriotism would be aroused This, of course must be taken into consideration when forming the so-called War Plan

The offensive war plan has to consider two main questions and select the one which will promise the greater result These questions are whether the aim of the campaign shall be the absolute destruction of the enemy forces or whether the occupation of the enemy's territory as a pawn for the securing of peace should be considered

A good example of the latter action can be found in the Russo-Japanese war For the Japanese army it was beyond question to force a final decision against the whole Russian army, therefore the next best thing was the occupation of Southern Manchuria.

With this general information concerning real issues we may now return to the War Game and see certain strategical and tactical details hitherto not considered

Considerations in Planning a War Game

First of all the aim should be to make the War Game as close an imitation of the real war as is possible This means that every detail which must be considered in actual warfare should also be considered in the War Game If the War Game handles only small detachments and small encounters there is much more chance to go into particulars and learn more than from a superficially directed large undertaking Therefore, detachments of the

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The Heavens in June, 1916

New Method of Determining the Distance of a Star

By Prof. Henry Norris Russell, Ph D.

A VERY remarkable piece of work from Mount Wilson deserves the first place in the column this month—namely, a spectroscopic method of determining the distances of the stars

The very idea of such a thing would have seemed absurd not many years ago—that, from the mere study of the character of the light sent out by a star, it might be possible to find out how far away the star is But the thing becomes reasonable when it is realized that the details of the spectrum of a star may depend upon its *real* brightness, and that, by comparing this with the *apparent* brightness which it presents to the eye, the distance of the star may be found

It has been known for nearly 50 years that, when the light of a star is passed through a prism, and collected by a telescope the resulting spectrum is crossed by dark lines, which, as in the case of the sun, reveal the existence in the star's atmosphere of various gases and vapors, each of which absorbs certain definite kinds of light, leaving tell tale dark lines to reveal its identity, and also that, though the spectra of different stars were unlike, they might be divided into a relatively small member of classes, each containing hundreds of stars whose spectra were almost exactly similar to one another, while other stars formed links connecting one of these classes with the next by almost imperceptible gradations

These principal classes of stellar spectra (which are now commonly known by the letters B, A, F G, K, M assigned in the Harvard classification) bear definite relations to the real brightness of the stars It is found that all the stars whose spectra are of the kind called B (showing lines of helium as do the stars in the belt of Orion) are very great real brightness, fifty or a hundred times as bright as the sun, or more The stars of spectrum A (like Sirius) are also of high luminosity, though not so bright on the average as the last named Among the yellower and redder stars, whose spectra are denoted by the letters G, K and M, it is found that some are very bright, and others faint In every group can be found some stars as much as a hundred times as bright as the sun, but the faintest stars of Class G (resembling the solar spectrum) are not more than one quarter as bright as the sun, and some of those of Class M are less than 1 100 as bright as the central body of our own system.

From a mere glance at the spectrum, then, if we find it to be of the B or A type, we know that we are dealing with a star of great real brightness, and that if it looks faint to our eyes it must in reality be very remote But if the spectrum should be of Class K for example, some of whose members are actually very bright and some very faint we would be at a loss to say whether a star which looked faint to our vision did so because it was really of small luminosity, though relatively near us or because although really far brighter than the sun, it was so far away that it appeared to us as a faint point of light

The recent work of Prof Adams at Mount Wilson just fills this gap With the great telescope there photographs have been made of the spectra of hundreds of stars, some known to be our nearer neighbors, and bodies of relatively feeble luminosity, others remote, and of very great real brightness The various spectra were then classified and compared An untrained observer, examining the photographs, would be unable to see any difference between the spectrum of two stars of the same general spectral class one of high and the other of low luminosity but when a careful study was made, it was found that there were a few lines in the spectrum which were distinctly stronger compared with the general run, in the spectra of the former class, and weaker in the latter case, while a few other lines showed an opposite behavior Upon comparing the estimated intensity of these lines with the real bright ness of the stars, it was found that the connection was remarkably close. All the stars in which these characteristic lines were of the same intensity, compared with their neighbors, turned out to be of very much the same real brightness, and the changes in the intensities of the lines for stars of different real brightness, could be represented, when plotted, by smooth curves

Having found this to be the case, the procedure was reversed For a number of additional stars, the intensities of the spectral lines were estimated, the corresponding real brightness read from the curves already prepared, and the distance computed at which the star would have to lie in order that, if of this real brightness, it might appear of the brightness actually observed. The resulting "computed parallaxes" were then compared with the actually observed parallaxes of the stars, and showed an extraordinary agreement.

More than 80 stars have so far been investigated, and it is found that the new spectroscopic method makes it possible to estimate their distances with a probable error of not more than 25 per cent. A range of probable uncertainty of one quarter of the true value may seem large, but these stars are not very near us, and to do better by any direct method of measurement would require a long series of exact observations, which would consume from 20 to 50 times as much labor as the spectroscopic method

It appears, therefore, that Prof Adams has presented to the astronomical world a most valuable instrument of investigation, by means of which information regarding the distances of the stars may be accumulated many times faster than had previously seemed possible So far, the new scheme has been tested out mainly on the stars whose real brightness does not many times exceed that of the sun If it proves as successful for those which are much more luminous, it will open up a still wider field, and there seems every reason to anticipate that it will

At 11 o'clock June 7
At 10½ o'clock June 14
At 10 o'clock June 22

At 9 o'clock July 7
At 8½ o'clock July 14
At 8 o'clock July 22

At 9½ o'clock June 30

NIGHT SKY. JUNE AND JULY

The Heavens

The finest region of the evening sky is in the south and southeast, where Scorpio and Sagittarius shine among the great star clouds of the Milky Way The naked-eye observer may note the contrast in color between Antares (α) and the neighboring stars—the former being of the spectral Class M, and extremely red and the others of Class B, and very white—and the pretty double star μ, which would be easy to separate were it not so low in the sky Telescopically, the whole of this region of the Milky Way is full of rich fields. One great star cluster north and west of λ Scorpio is especially fine, even in a field glass.

Farther to the left we come upon Aquila, and the two small groups Delphinus and Sagitta, beyond which is Cygnus, with Lyra above it.

Cepheus and Cassiopeia are low in the northeast, Ursa Minor and Draco high in the north, and Ursa Major high on the northwest.

Hercules and Bootes are almost overhead, and Ophiuchus and Lupus are south of them. Virgo, Leo and Corvus are the most prominent constellations in the southwest and west.

The Planets

Mercury is in conjunction with the sun on the 5th, and becomes a morning star He draws rapidly out to the westward, and reaches his greatest elongation, 22 deg, on the 30th. At this time he rises about 3:30 A.M, and can easily be seen before dawn.

Venus is an evening star, but is rapidly approaching the sun. On the 1st she remains in sight till after 10 P.M, but by the end of the month she sets only 15 minutes later than the sun, and is practically invisible. Telescopically, she shows a conspicuous crescent, which is visible even with a good field glass.

Mars is an evening star in Leo, setting half an hour after midnight on the 1st, and about an hour earlier on the 30th He is far fainter than at opposition, but is still a conspicuous object, as bright as Regulus.

Jupiter is a morning star in Aries, rising about 1 30 A.M. Saturn is an evening star in Gemini, easily visible at the month's beginning, but lost in the twilight at its close On the 22nd Saturn and Venus are within a degree of one another, but both will be too low to be easily seen.

Uranus is a morning star in Capricornus, crossing the meridian at 3 50 A.M. on the 15th. Neptune is in Cancer, observable only just after sunset.

The Moon is in her first quarter at 7 P M on the 8th, full at 5 P M on the 15th, in her last quarter at 8 A M on the 22d, and new at 6 A M on the 30th She is nearest us on the 16th and farthest off on the 3d, and again on July 1st.

As she completes her circuit of the zodiac, she passes by Mercury and Saturn on the 1st, Venus on the 3d, Neptune on the 4th, Mars on the 7th, Uranus on the 19th, Jupiter on the 24th, Mercury again on the 28th, and Venus on the 30th

Wolf's Comet

A faint comet, with so definite a nucleus that it almost resembled an asteroid, was discovered by Wolf at Heidelberg on April 27th.

The last observation which has so far come to hand, placed it, on May 10th, in 12 h 34 m right ascension, and 3° 24' north declination, moving about 50 seconds west and 3' north per day Though the elements of its orbit will probably very soon be computed, they are not available at the time of writing

Princeton University Observatory,
May 22nd, 1916.

The Current Supplement

A NOTABLE article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2109, for June 3rd, deals with *The New York Zoological Park*, which, while not covering as much ground as some others, is one of the most notable parks of its kind in the world, both on account of its collections, its splendid accommodations and its unusual natural beauty The description is accompanied by a map and by a large number of splendid illustrations. Another illustrated article of timely interest is *Airships Rigid, Semi-Rigid and Non-Rigid*, which describes some of the internal details of the various craft now in use abroad. There is a short account of some new apparatus for *Enlarging and Projecting* photographs by artificial light. There is another installment of the valuable lectures by Sir J J Thomson on *Radiations from Atoms and Electrons*, which should be read by everyone who desires to keep up with the latest advances in fundamental science The final lecture will appear in the next issue. *Science for the Home* tells about the losses and other chemical changes in boiling vegetables, and is a valuable article for the housekeeper and the dietician. *The Development of the Military Aeroplane* is an exhaustive discourse by a recognized authority on aeronautic engineering and is illustrated by diagrams. *Special Steels* discusses these materials with regard to their use in motor vehicles. *The Utilization of Cull Citrus Fruits* tells how great quantities of valuable material may be saved for useful purposes. There is also an unusual number of shorter articles of value.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A Permanent Tennis Tape Which Is Made Like a Double-blade Saw

THERE has been recently introduced a novel system of marking tennis courts, which appears to have eliminated all the troubles experienced with the use of other methods of marking. For one thing it is permanent, which means that it is always ready for the players.

The new tennis tape is made of galvanized iron cut in sections that are easily handled, and made so as to outline the exact dimensions of the court. As indicated in the illustration the tape is driven into the ground and held in place by the vertical saw like teeth, and no difficulty is experienced in setting the teeth into the ground, since each tooth is sufficiently flexible to be deflected if it encounters a stone or pebble. The flexibility of the teeth is of prime importance when the tapes are driven into the ground many of the teeth flare inward or outward, thus clinching the tapes so securely that in play it is impossible to dislodge them, according to the inventor.

The advantages of the galvanized iron tennis tapes over those of canvas are numerous. The former do not shrink when wet nor get loose when dry. Since they are flush with the surface of the court, it is impossible to trip over them. The lines made by the metal tennis tapes are absolutely straight and permanent. In the fall they may be taken up, washed and painted if desired, and relaid the following season. If the teeth of any one section be too much bent, a new section can be substituted at a trifling cost.

A new method of marking tennis courts, using galvanized iron strips provided with saw-like teeth

A Device that Brews Perfect Tea Automatically

THERE has recently appeared a simple little device known as the "tea bob" for the brewing of perfect tea. The latter expression is used advisedly for the tea bob produces a beverage that is always of a uniform and proper strength.

As will be noted in the accompanying sectional views of a teapot in which is placed a tea bob, the new device is of simple construction. It consists of several parts, the first of which is the hollow cylinder with perforations about one third up from the bottom. Into the lower end of the cylinder fits an air tight float, which is removed only to permit of placing the tea leaves in that portion of the cylinder which is perforated. Into the top of the cylinder fits the time cup, and the three parts, all of seamless aluminum, thus joined in one are inserted in the earthenware pot.

As many cups of boiling water as the number of cups of tea desired are poured into the time cup. A certain self measured quantity of this water is automatically retained in the time cup, while the balance runs through the large holes near the upper edge of the time cup, falling upon the leaves in the holder below. The cover is then placed on the time cup, and no further attention is necessary. In the bottom of the time cup is a mathematically-proportioned hole that allows all the water in the time cup to escape at the instant of perfect infusion. As long as any water remains in the cup, its weight holds the float at the bottom of the pot and keeps the leaves immersed in the fresh boiled water. At the instant of perfect infusion, the water has all escaped from the time cup and the float rises, lifting the tea leaves out of the beverage. The tea can then be served or if desired it may be served in five, ten or even thirty minutes, as there is no danger of over steeping, since the tea leaves have been removed. The beverage is said to be rich in theine, yet entirely free from tannin, because the brewing of the tea is limited to four minutes; this time limit is regarded by the experts of the London Tea Market to be the standard for obtaining the best results.

Two phases in the operation of the tea bob

Position of the tea bob after the time cup is filled with water with tea below

Position of the tea bob after the tea is brewed with time cup empty

Making a Motion Picture of a One Hundredth Second Shutter Exposure

PRODUCING a motion picture film containing 100 pictures of a camera shutter exposure of the order of 1/100th second, each picture showing a distinct location of the shutter leaves at intervals of 1/1000th second and allowed an exposure of but 1/30000th second, appears at first to be a difficult task. Yet an apparatus for just such a purpose has been developed in the research laboratory of a leading American camera manufacturer for the purpose of testing camera shutters.

The shutter testing apparatus is simple, contrary to expectations. It has for its main member an aluminum disk mounted on a vertical shaft driven at 50 revolutions per second constant speed by a specially governed electric motor. Around the edge of the disk are 20 small mirrors. Since there are 20 mirrors and they revolve 50 times in a second, there are 1000 reflecting planes per second which will fall in the path of a horizontal light ray supplied by a small electric arc. The reflected ray is sent through a horizontal tube or barrel in which rests the shutter to be tested. Behind it is placed a lens which focuses on a motion picture film carried on a horizontal reel inclosed in a box and turned by a handle. As the successive light rays pass through the shutter the instantaneous image of the latter is photographed on the film which, being in motion, advances in time to receive the next exposure further along its length. So it is that during one click of the shutter, which to the lay mind is regarded as an 'instantaneous' exposure, the motion picture film has impressed upon it a series of pictures showing the gradual opening, the full opening and the gradual closing of the shutter leaves—of course speaking in thousandths of a second. With full knowledge of the timing of the successive pictures on the film it affords valuable data to shutter designers.

While it is true that the shutter testing apparatus is a novelty it is not to be considered in the light of a laboratory experiment. Through its use it is possible to study the rate of opening and closing of any shutter and to improve its design and optical efficiency as a result of this study. Aside from studying the speed of a shutter by this means it is also possible to secure data as to the quantity of light that passes through for any aperture and any time. A shutter designed to open in the smallest possible time and to close in the shortest possible time is the most efficient one and science is nearer to approaching this perfection than ever with the aid of the new apparatus.

Apparatus for making motion pictures of a camera-shutter exposure, now employed in a camera manufacturer's laboratory

A motion picture film of a 1/100 second exposure of a camera shutter, showing the position of the shutter leaves at various intervals

The first picture shows the leaves just starting to open. In the second picture they are half open while in the third they are almost entirely open. The next three views show the shutter wide open, and the next three show it closing in successive stages. From these pictures it is learned that the shutter consumed 3/1000 of a second in opening, 3/1000 of a second wide open, and 3/1000 of a second in closing.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

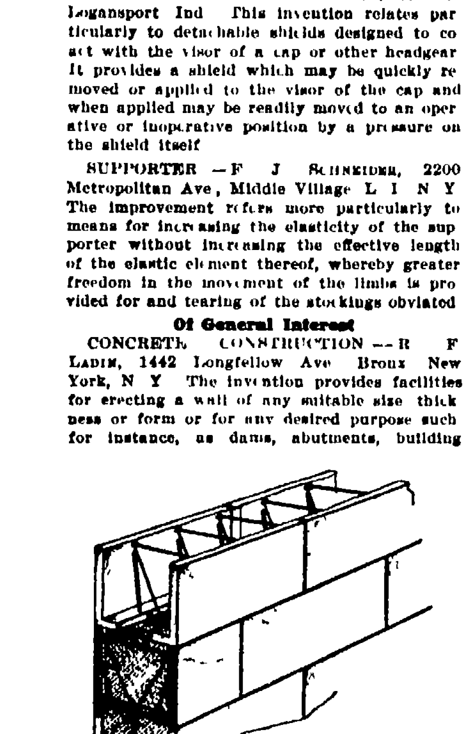
HAT PIN.—MARGARET L. NOXON, 205 W 102d St, New York N Y This invention provides a hat pin with a pin tongue which is connected with the pin by a spring which is bent back and forth longitudinally of the pin tongue to permit the ready disengagement of the spring from the hair and veil on the head of the woman making use of the hat pin

EYE SHIELD.—A N BAKER 410 4th St. Logansport Ind This invention relates particularly to detachable shields designed to coact with the visor of a cap or other headgear It provides a shield which may be quickly removed or applied to the visor of the cap and when applied may be readily moved to an operative or inoperative position by a pressure on the shield itself

SUPPORTER.—F J SCHNEIDER, 2200 Metropolitan Ave, Middle Village L I N Y The improvement refers more particularly to means for increasing the elasticity of the supporter without increasing the effective length of the elastic element thereof, whereby greater freedom in the movement of the limbs is provided for and tearing of the stockings obviated

Of General Interest

CONCRETE CONSTRUCTION.—R F LADIN, 1442 Longfellow Ave Bronx New York, N Y The invention provides facilities for erecting a wall of any suitable size thickness or form or for any desired purpose such for instance, as dams, abutments, building

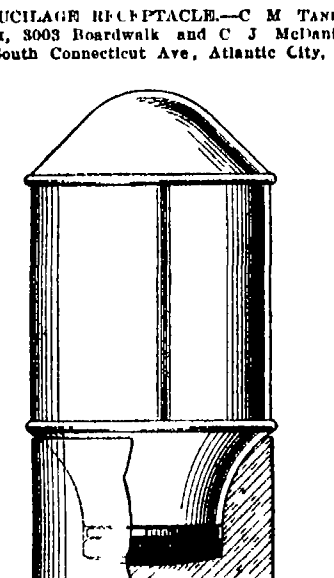


CONCRETE CONSTRUCTION

walls or the like either vertical or battering by the employment of means including a plurality of plates panels or blocks designed to be arranged opposite each other in pairs and suitably connected in spaced relation and with the space filled with plastic material said plates or blocks together with the plastic material coöperating and combining to form the structure

REINFORCEMENT FOR PAPER CORES.—E L STUCK, Rothschild Wis This invention is an expansible reinforcement and stiffener for the tubular paper cores or bodies on which paper rolls are wound Such cores are usually made of paper or some like material, and are provided with reinforcements which are riveted in place and hence are not detachable, but permanently associated with the core

MUCILAGE RECEPTACLE.—C M TANENBAUM, 3003 Boardwalk and C J McDaniel 19 South Connecticut Ave, Atlantic City, N

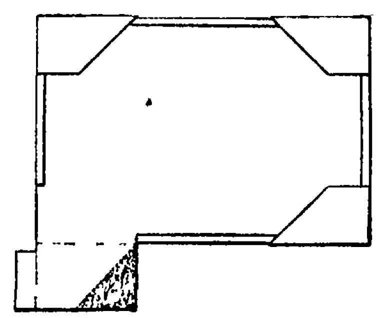


MUCILAGE RECEPTACLE

J This invention provides a safe and economical device for household and office use at a small cost and known as a Safety Mucilage Bottle The advantages secured by the invention are A brush is not needed the mucilage will spread evenly, it is always handy and ready for use there is no waste of material and it will neither harden nor dry out the contents will not spill when the bottle is upset it is simple in construction, strong and durable and a saver of time and in its use the fingers are in no danger of getting sticky

NON REFILLABLE BOTTLE.—C S COHN, 131 N. 18th St., Portland, Ore. This improvement has reference to bottles having means to prevent the refilling thereof, and more particularly it relates to novel valve means designed to automatically effect a closure of the bottle in any attempt to refill the same with the bottle in different angular positions.

BOOK COVER PROTECTOR.—G FORTUNE, 4424 Franklin Ave Norwood, Ohio This invention relates to book protectors for the backs and covers of books, and one of the principal



BOOK COVER PROTECTOR

objects of the invention is to provide a simple protector of fabric or tape of strong paper, and in different sizes, said protector having pockets at the corners for receiving the corners of the cover of the book, thus providing a protector which is easily connected to the book and which will extend entirely over the back and cover of the book

Household Utilities

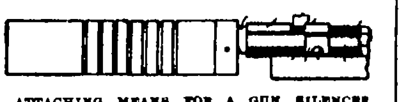
DETACHABLE HANDLE FOR COOKING UTENSILS.—T C PHELPS Address Gustave Disch 523 Broadway New York, N Y The primary object of this invention is the provision of a simple and efficient form of handle or bail adapted to be detachably connected to any suitable type of frying pan stewing kettle or the like the manner of connecting the handle to the vessel providing for the maximum stability and rigidity

IRONING BOARD.—J POLI and R POLI care of Rainger Wilhartz Louer and Concannon Fort Dearborn Bank Bldg Chicago Ill This improvement relates to the ironing of garments, linen and the like and the main object thereof is to provide an ironing board the outer end of which is entirely free in order that shirts skirts and the like may be arranged thereon without the necessity for raising the board.

CAP FOR MEAT COOKERS.—A REUBOLD 1340 Chisholm St, Bronx N Y N Y The invention relates particularly to cookers of the character described and claimed in Letters Patent of the United States No 1 066 792 issued to Mr Reubold Among the objects of the present invention is to improve the cap portion of this structure so as to make it easier to manipulate and more reliable in use than previous devices

Machines and Mechanical Devices

ATTACHING MEANS FOR A GUN SILENCER.—A T PRATHER Rodeo New Mex In this patent the invention has for its object the provision of means for securing a gun silencer to the muzzle of a gun in a manner which will direct all the explosive gases



ATTACHING MEANS FOR A GUN SILENCER

through the silencer thereby preventing any escape of the gases rearwardly between the fastening means and the barrel of the gun The accompanying engraving represents a gun silencer attached by the inventor's improved means to the muzzle of the gun

OVERHEAD SWITCH AND STOP.—W ROTHE 114 E 91st St., New York, N Y This invention relates to overhead trackways such as are in use in warehouses, meat markets and similar places. It provides an automatic stop device for use in connection with a switch said device becoming functional simultaneously with the shifting of the switch to make it impossible for a trolley to accidentally run into an open switch

AUTOMATIC STOP FOR MOTOR DRIVEN MACHINES.—S DE P CURRY Address A. B Curry P O Box 292, Key West, Fla. The prime object here is to provide a stop for the sewing machine adapted to be mounted so as to be controlled by the rocking movements of the motor and to instantaneously arrest the balance wheel or hand wheel of the sewing machine upon the release of the driving connection with the motor

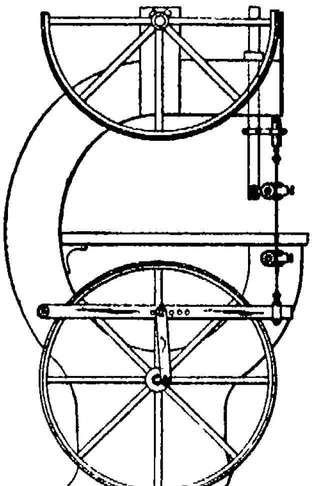
VALVE MECHANISM.—G P B HOYT, 1 Clifton Place Jamaica Long Island New York N Y The mechanism is more especially designed for use on internal combustion engines and arranged to govern the admission of the explosive mixture and the exhaust of the products of combustion and to prevent leakage of the explosive mixture during the compression and explosive periods thus rendering the engine highly efficient.

PROTECTOR AND GUIDE.—M P WILLIAMS, Box 492, Gilbertville, Mass. The invention provides a protector and guide arranged to prevent adjacent threads becoming entangled in case one breaks, to insure proper twisting of the threads without danger of the threads dropping under the roller or stopping the machine, and to enable the operator to quickly and correctly pass the thread around the roller and into the guide at one operation.

DENTAL APPARATUS.—S. F KOHN, 199 Brown Place, Brooklyn, New York, N. Y. The invention provides an apparatus with means for furnishing a steady supply of air and gas to sustain a burner flame, provides a unit engine for performing a series of allied functions and provides an apparatus with a prime mover operatively connected with a series of mechanisms for performing allied and progressively required functions, and with a receptacle for holding tools and accessories to said mechanisms.

TENSION DEVICE FOR WARP BEAMS.—G KELLER, 164 E 116th St, New York, N Y This improvement provides a tension device for warp beams arranged to permit of conveniently and accurately adjusting the device to any desired degree according to the tension desired on the warp and to enable the operator to quickly throw off the tension on the warp beam whenever it is desired to release the warp for any reason

CONVERTIBLE SAWING MACHINE.—N A. SVENSON, 94 Hillside Ave., Wakefield Park, N Y This machine can be readily converted from a band saw to a jig saw and vice versa The invention provides an ordinary band saw with a jig saw attachment and without disturbing the general construction of the band



CONVERTIBLE SAWING MACHINE

saw To accomplish the results desired, use is made of a lever connected by a pitman with a crank pin on one of the revolving parts of the band saw preferably the lower pulley a saw holder at one end of the lever to which one end of a jig saw blade is attached and a spring mounted on the guide post of the band saw and connected with the other end of the jig saw blade.

Medical Implements

NEEDLE FOR HYPODERMIC SYRINGES.—H LAURENT East Rutherford, N J This invention provides a needle shank to prevent the needle shank from breaking off at the needle hub, to cause the fluid in the barrel of the syringe to flow directly into the needle and to allow of readily engaging the butt end of the needle shank with the bore in the outlet of the barrel when placing the hub exteriorly in position on the said outlet.

Prime Movers and Their Accessories

STEAM ENGINE.—A R. CARTER 207 E. Thomas St, Hammond, La This invention is an improvement in the type of multiple-piston steam engines and the objects are to reduce the cost, weight, and friction of the parts connected with the pistons and crank shaft as well as to minimize friction and vibration Mr Carter has invented another steam engine, such as forms the subject of his allowed application for patent No 44 563 The present invention is of simpler type there being but two pistons and the cylinder provided with but three inlet and exhaust ports. It is therefore particularly adapted for light work and to still further adapt it he has made it easily convertible from a two piston to a single-piston engine by means at once simple but effective

POWER CHAMBER.—J F SCOTT, 407 W 23rd St, New York N Y The invention relates to internal combustion engines and particularly to a power cylinder and provides a construction which will eliminate the necessity for the use of lubricating oil in the cylinder It provides a cylinder which utilises the expansion and contraction of the body thereof for operating a power member, as, for instance, a connecting rod instead of utilising the conventional piston

ROTARY EXPLOSIVE ENGINE.—R E. ZUENDT, 112 Cumberland St., Little Rock, Ark The invention relates to improvements in rotary explosive engines using a mixture of gasoline and compressed air, and provides a device which will combine the advantages of a rotary engine with those of the ordinary type of reciprocating engines.

Railways and Their Accessories

LOCOMOTIVE DRIVING WHEEL.—M. L. DAVIS, JR., Oak Grove, Ala. This invention relates to a driving mechanism for traction wheels and particularly to a locomotive driving wheel and mechanism, and has for an object the construction and arrangement of an improved driving wheel where the friction is reduced to a minimum.

FEED WATER HEATER.—C. BOCKELL, 823 East Main St., Washington, N. C. This invention provides a device by means of which the water with which the boiler is charged may be heated prior to its admission to the boiler by heat from the fire box, with means for preventing a disastrous discharge of steam into the cab of the engine from the fire box in the event of the burning out of the water heating parts which are disposed in the fire box.

RAIL ANCHOR.—N J SCHELL, Beaver Falls, Pa. The anchor comprises two interlocking rail gripping members adapted to coöperate with a tie to prevent the creeping of the rails, which, owing to the peculiar construction of engaging tongue and groove formed upon the interlocking rail engaging members, will more firmly engage the rail as it tends to creep or slide, but in which the original gripping position of the members upon the rail base will not be changed by such tightening.

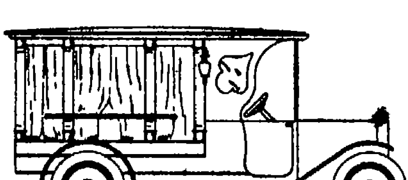
Pertaining to Recreation

TOY SUBMARINE BOAT.—M W LEHMAN, 822 Macon St., Brooklyn, New York, N Y Among the objects of the invention is to provide a cheap and attractive imitation of a submarine boat, the same being designed to submerge automatically and then subsequently rise to and float upon the surface by a continuation of the same automatic operation

FISH HOOK.—J Y PATTON, Waldron, Ark. The invention relates particularly to improvements in automatic fish hooks. The general objects are to improve the construction and operation of fish hooks of this character so as to be reliable and efficient in use, simple and inexpensive to manufacture, and so designed that the bait carrying hook will act smoothly and effectively

Pertaining to Vehicles

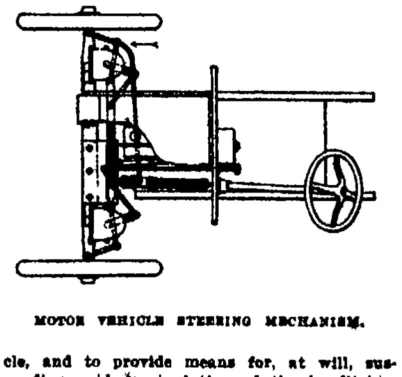
PORTABLE SHELF FOR HEARSES.—R S MOORE 229 E 75th St. New York, N Y This invention provides a collapsible and portable shelf adapted to be carried under the seat



PORTABLE SHELF FOR HEARSES

of the vehicle or in any other convenient place, and capable of being quickly attached to a side of the hearse in position to receive the flowers temporarily, while the casket is being handled After the casket is placed and the flowers disposed of in the usual manner, the shelf is removed from the supporting position and put away for subsequent use

MOTOR VEHICLE STEERING MECHANISM.—G W RICE, Manistique Mich Among the principal objects which the invention has in view are To provide means for manipulating the headlights of a vehicle in correspond ence with the steering mechanism of the vehicle, and to provide means for, at will, suspending said manipulation of the headlights.



MOTOR VEHICLE STEERING MECHANISM.

The engraving represents a top plan view of the front fragment of a motor vehicle, showing the steering wheels and mechanism controlling the same, and in conjunction therewith a headlight controlling mechanism.

Designs

DESIGN FOR A SPOON.—J A MULCAHY, Deer Lodge, Mont. The ornamental design shows a birthday spoon set with a birth month stone The setting is at the end of the handle of the gracefully designed spoon.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—W E. HUNTER, care of Economy Tumbler Co., Morgantown, W Va In this design for an article of manufacture there is represented a goblet on which is delineated a cartouche comprising a combination of fleur-de-lis, foliated borders, bells, pendants, floral features, vase, rosette, etc.

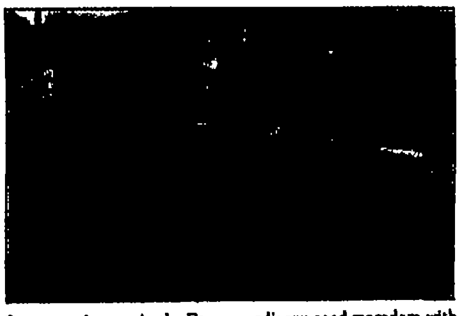
NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

In spite of the presence of street railway tracks, 180th Street has been maintained with Tarvia successfully since 1912. An annual coat of "Tarvia-B" keeps it smooth and dustless.

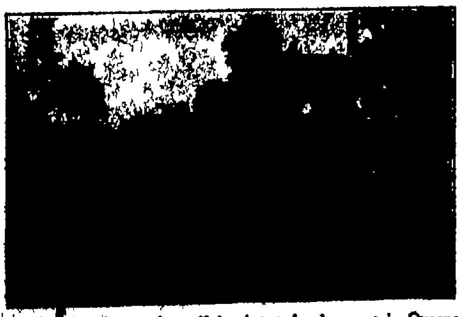
There are hundreds of miles of rural highways like this in New York City. This is Amboy Road on Staten Island maintained with "Tarvia-B" since 1909

After a disastrous adventure with oil this section of the famous Riverside Drive had to be rebuilt. Tarvia has kept it automobile-proof since 1914

233d Street in the Bronx—Tarvia solves the paving problem for outlying sections which cannot afford regular city pavements



Carpenter Avenue in the Bronx—ordinary good macadam with a carpet coat of Tarvia to prevent dust and wear



In Kew Gardens, a beautiful private development in Queens Borough. The roads are built with "Tarvia-X" and well kept with "Tarvia-B."

400 Miles of Tarvia in New York City

OVER 4,000,000 square yards of macadam roadway in Greater New York have been treated with Tarvia to preserve the surface and prevent dust.

This is equivalent to more than 400 miles of ordinary roadway.

Tarvia

Preserves Roads
Prevents Dust

New York has used Tarvia for ten years in steadily increasing quantities because they have found it a most satisfactory and economical road binder and dust preventive

The Grand Boulevard and Concourse in the Borough of the Bronx is the largest single example It is a double roadway, four and a half miles long containing 190,000 square yards, used exclusively for pleasure vehicles It was built as a water-bound macadam and treated with "Tarvia-A," part in 1911 and the balance in 1912

The first complete maintenance application was one-seventh of a gallon of "Tarvia-B" to the square yard covered with sand and grit in 1915 The cost of incidental repairs aside from the maintenance application was about one dollar per 1,000 square yards for the year 1915

Hillside Avenue in Queens is a good example of durability under mixed heavy traffic It also was a water-bound macadam road and was treated with "Tarvia-A" in 1910 The maintenance cost has been extremely low The original Tarvia is still on duty and the road surface clean, smooth and dustless

The descriptions under the various photographs, shown herewith, tell the story of many other satisfactory Tarvia Roads in Greater New York

If you are interested in good roads and lower taxes, write our Service Department for booklets and further information Address our nearest office

Special Service Department

In order to bring the facts before taxpayers as well as road authorities, The Barrett Company has organized a Special Service Department, which keeps up to the minute on all road problems If you will write to nearest office regarding road conditions or problems in your vicinity, the matter will have the prompt attention of experienced engineers. This service is free for the asking

If you want *better roads* and *lower taxes* this Department can greatly assist you.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh Detroit Birmingham Kansas City Minneapolis Salt Lake City Seattle Peoria

The Paterson Manufacturing Company Limited: Montreal Toronto Winnipeg Vancouver St John, N B. Halifax, N S. Sydney N S.

Grand Boulevard and Concourse in the Borough of the Bronx (See the main body of text)

This is Jerome Avenue one of the principal automobile outlets from the city to the north carrying enormous traffic on holidays "Tarvia B" keeps it free from dust

At Forest Hills in the Borough of Queens the Sage Foundation has built an enlightened model development as an investment for its funds. They studied the road question with great thoroughness and adopted Tarvia both for construction and maintenance.

This avenue is in the beautiful Flushing section where Tarvia has done wonders in keeping beautiful residential areas from being spoiled by automobiles

Hillside Avenue Jamaica How a six year-old Tarvia job looks on one of the busiest automobile thoroughfares out of Brooklyn (See text.)

This is the Shore Boulevard at Manhattan Beach in Brooklyn—a pleasure center in the summer It gets a coat of "Tarvia-B" once a year

"—GOOD ENOUGH FOR TECH —GOOD ENOUGH FOR ME!"

Products Selected to Build the New Massachusetts Institute of Technology

Agricultural Unpreparedness

By Grosvenor Dawe

WHEN the thought of every reader of the SCIENTIFIC AMERICAN will be directed toward the subject of "Industrial Preparedness for Peace," it may not seem inappropriate to draw attention to our agricultural instability as a definite phase of national unpreparedness

The census of 1910 contained facts of a disturbing nature as to our agricultural population It showed that 980 counties of the United States—more than one third of all the counties—in the decade between 1900 and 1910 fell off in their rural population It must be borne in mind that while one third of the counties were thus declining in rural strength, the nation, nevertheless, gained 16,000,000 in total population, indicating a steady movement of the agricultural population to the cities

Senator Moses E Clapp of Minnesota, in a recent letter regarding this subject, said "I believe the greatest problem to-day that confronts the American people is the trend of our population to the cities It is the great — probably the greatest—contributing factor in the ruin of nations that have perished'

The same census shows that concurrently with this decline in rural population there has been a rapid increase of rural tenancy In 1910 there were 2 354,676 farms run by tenants in the United States, or more than one quarter of all the farm area of the nation The great majority of these tenants were on short leases and therefore not interested in maintaining land fertility Increasing tenancy implies an increasing number of people who rent but do not own, who are nomads, in one place for a while and then gone, whose children know nothing of the associations of the word ' Home ", whose possessions have none of the memories attached to them by those who live on their own piece of ground whose roots do not strike down into the soil

In the trend of the rural population to the cities, and in the rapid increase of tenancy are two weakening forces both of which have been growing in momentum and in power Both of them, unless checked, will hinder industrial prepared ness for peace.

Not with any intention of overpraising agriculture as compared with the mechanic arts, but solely because of the national good judgment immediately required in the premises, it is necessary to emphasize here that the open spaces produce all the raw materials, except metal, which go into clothing, from the shoe on the foot to the feathers in the hat They produce every raw material that goes into food, except salt, they produce every piece of lumber that goes into a house, a wagon, or the wood pulp on which our newspapers are printed Far more than 50 per cent of all the goods manufactured in the United States are produced from things that live and grow in the country Without the country the city cannot live without the city the country would still live by turning back to the simplicities of pioneer days Consequently, industrial increase urged forward while agriculture weakness grows would simply accentuate the cost of industrial life, for increasing consumers mean increasing prices, and therefore a higher and higher cost of living

It is not the increased cost of mere living that is the most alarming result from this tendency It is that the rural people get into the clash of competition and the strain of city life in many cases increasing the struggle of city life to the detriment of themselves and others. They turn their backs on the comparative freedom and independence of rural regions and often become bowed down in a sort of industrial slavery, for without money to be spent for food they cannot live Many hold jobs that crush out courage and individuality Hence cities are the homes of soup kitchens, charity organizations, bread lines, and all those features which tend to disrupt and destroy the freedom and the independence of the citizens of a nation. In a recent canvass among the jobless of Chicago 20,000 men under 25 years of age, and chiefly from the farms of the Middle West, were found huddling in squalid places

Therefore, preparedness for peace means much more than industrial preparedness The term should be wider, broader It should be National Preparedness for Peace and thus take in every phase of activity from agriculture in the fields and work in the factories up to activities in the realms of commerce

The rapid industrial development of the last half-century is to blame for conditions which, if they continue, will ruin us as a republic These are not extreme words They are words of sober sense Unless the nation gives earnest and persistent thought to this problem of agricultural depletion and increasing tenancy all other phases of preparedness will become insignificant, for a republic made up of cities and of renters is scarcely worth defending as a home of free men The very fact that we live crowded together with other people brings us under the rule of law and ordinance to such an extent that in the cities there is but little difference between a democracy here and an autocracy elsewhere, in so far as freedom of action is concerned

Therefore, at this moment when we are so clearly called upon to consider the future of the United States, we must not be bewildered with the thought of merely planning to push out our commerce into foreign countries where hitherto we have had but a slight hold For after all is said that can be said about foreign trade, the manufactured exports of the United States prior to the great European war were not more than 5 per cent of the total consumption. It is doubtful, no matter how the war eventuates, whether with all our skill we can continue to send abroad in the immediate future more than 10 per cent of the manufactured goods normally required Therefore, industrial preparedness for peace implies a certain sort of national introspection, for we have hitherto been our own best market industrially, and the maintenance of ourselves as our own best market depends altogether upon the continuance of a right balance in our parts balance between country and city since it is the produce of the country that has always served best and most easily to bring other nations into debt to us It is such a process of introspection that is best for us at this moment, when we seem to be "led up into an exceeding high mountain,' with all the kingdoms of the earth spread before us These kingdoms contain but little for us, when contrasted with the immense things yet in store for us through balanced development within the limits of our own great area and population

A phase of the subject calling for earnest thought is that there is more money spent to render more facts of usefulness available for farmers than for all subjects affecting either business or labor In 1914 the agricultural and mechanical colleges subsisting on land grants, together with Farmers' Institutes, etc owned property valued at $160,000 000, and their total income from all sources, together with the cost of Federal and State Agricultural Experiment Stations, was $40,000,000.

In large measure supplementing this, though of course including appropriations for meat inspection, comes the Federal Department of Agriculture In 1907 its appropriation was $9,930,440; in 1915 it had risen to $19,865,832 Then every state has some part of its governmental machinery directed towards agricultural betterment, certain of these departments working powerfully and under large appropriations, and some working feebly Add to all such Federal and state activities certain great private benefactions that originated the Farm Demonstration Work, and now are partly paying for County Farm Advisers, then add contributions from commercial bodies convinced of the agricultural basis of city growth; then add the various railroad systems, with their agricultural departments and demonstration trains, and we have something majestic in total, said to exceed $100,000,000 a year It becomes evident, therefore, that merely pouring out agricultural advice has not stopped the trend of things.

Careful research among the census figures indicates that rapid increases in land values on a seemingly indefensible basis may have something to do with driving men from the land To make this point clear, there have been brought together for consideration by readers of the SCIENTIFIC AMERICAN certain figures from the great agricultural state of Illinois—the state that has 7 out of the 12 greatest agricultural counties of the nation. In that state there are 102 counties. The census of 1910 showed that 68 of these had declined in rural population. Yet in every one of these 68 counties the prices of land advanced in percentages ranging from 28.3 to 182 4 For these 68 counties the average decrease of population was 6 6 per cent the average increase in land values was 180 4 per cent

There is also the question of high interest rates charged the farmer by those who have money to loan By drawing upon Census Reports and gathering opinions from financial sources, it appears that in 1910 the American farmer was indebted in these amounts

Farm mortgages on land operated by owners—United States Census figures	$1,726,000,000
Mortgages on tenant farms, at same rate per acre as above estimates	1,320,000 000
Average amount of current loans to farmers, on account of crops, chattels, etc.	3,000,000,000
	$6,046,000,000

"From all I have been able to gather from the best available sources,' said B F Yoakum in *World's Work* "I estimate that an average rate paid by our farmers is 8½ per cent per annum, which is a conservative estimate of the full cost paid on farm money used in the financing and capitalization of the farms of the United States The annual interest bill, therefore paid by the farmers is about 510 million dollars"

If the above enormous total of indebtedness is assumed to have increased during the past five years, it is probably not now less than $6,600,000,000 If it were furnished at 5 per cent interest, without bonus or commission the farmer, after deducting recording fee, could make a net economy of $225,000,000 per year What this would mean in the form of permanent investment is this $225,000,000 per year invested in advance at only 3½ per cent interest would amount in 25 years to $9,070,425,000 plus

Within the limits of this article it is only possible to show an ailment in the body politic, a weakening of the conservative producing class, a danger The cure of the ailment is not to be hastily prescribed

A Census of Colors

(Concluded from page 578)

of Naphthorubine, Primuline is encountered commercially, also as Polychromine, Thiochromogen, Aureoline, and Sulphine Malachite Green, a favorite color, is found under thirty-eight different designations, some representing very slight variations in the exact chemical composition.

The reduction of this extensive vocabulary down to the limited list of nearly 1,000 well-defined dyes has required highly specialized editing. The arrangement, and the full use of synonyms are such as to render the "census," when published, of the greatest utility, not only to all engaged in the manufacture of artificial dyestuffs and especially in planning for the establishment of a comprehensive American color industry—but also to all

dealers in the wares, and to all consumers of dyeing materials.

All three of these categories have hitherto been indebted to the painstaking labors of several prominent German color chemists, notably of Gustav Schultz and Paul Julius, for complete and detailed classifications of the coal-tar dyes in current use. The carefully elaborated "Farbstofftabellen," devised by the two authors, reached a fifth edition in 1914. These "tables," divided into groups according to chemical relationship, give for every artificial dye the commercial designation, the scientific name, the chemical formula, physical and chemical properties, methods of application, tests, and full references to patents and literature. They have for years been the *vade mecum* of all connected with the manufacture of colors, their commerce and their manifold uses

It has remained for a Bureau of our Government to supplement the work of the German duo, by adding the all important factor of quantity The complete exposition of the exact amounts of the many synthetic dyes, required to meet the almost numberless needs of a population of over one hundred million portrays approximately the relative demands of all other nations with highly organized textile and allied interests. The young American dyestuff industry, now in a position to expand rapidly and to embrace in its scope the great majority of the colors in current use, will naturally find in it a sure guide for coördinating the diverse phases of manufacture, establishing the capacity of units, and shaping all plans for harmonious expansion.

More than this, it will be of almost equal value to those seeking to create the national coal tar industries of Great Britain, France, Russia and Italy Even the newly organized industry in Japan may profit from its summaries, although in a less pronounced degree, on account of the widely divergent taste for colors between the Orient and the Occident.

Should China plan to manufacture her own coal tar dyes, but little help could be secured from the new work, in formulating schemes for installing plants. Synthetic indigo constitutes two thirds of the Chinese consumption of artificial colors. It enters to the extent of 14 per cent into the Japanese imports of dyestuffs, and forms but 10 per cent of the American consumption.

One of the first results of the compilation of this census was to show how exceedingly vague an idea of the extent to which synthetic dyes are consumed in the United States prevailed in commercial and manufacturing circles. Those most closely in touch with the branch have estimated hitherto that the annual American consumption of coal tar colors did not exceed 20,000 tons. As a matter of fact, it is nearly one half again this amount—more exactly 29,000 short tons.

In this Census of Dyestuffs, the country has an additional illustration of the manner in which the Department of Commerce is striving to anticipate the legitimate wants of those seeking to perfect the nation's industrial fabric and to promptly place in their hands the requisite tools.

Utilization of Cherry Waste Products

(*Concluded from page 573*)

shown that the juice because of its high sugar content is capable of being converted into several products of commercial value

By neutralizing the acidity of the juice with milk of lime and subsequent filtration and evaporation, a sirup with a pleasant, sweet, slightly tart taste is obtained The yield of sirup obtained is about 20 per cent of the juice.

Subjection of the juice to fermentation with subsequent distillation produces a yield of 4.6 per cent of alcohol (95 per cent by volume).

If the juice is boiled with pectin or other jelling medium and sufficient sugar, an excellent jelly with a rich fruity odor and a very pleasant slightly tart taste is obtained.

A conversion of the total quantity of juice available annually into any of these products would result in the production of about 3,000 gallons of alcohol, 15,000 gallons of sirup or 55,000 gallons of jelly. The value of any of these products is difficult to estimate; the two latter, however, would doubtless be most profitable because of the demand existing for commodities of this character

The facts presented argue strongly for a rational application of the processes of utilization to the waste pits and juice of cherries, which result so extensively in the packing of this important fruit.

Realizing Industrial Preparedness

(*Concluded from page 576*)

men, and are now engaged in inventorying the resources of their respective communities. To assist them in this work, the entire membership of the five societies, some thirty thousand engineers and chemists in all, are serving as Field Aides. Thus an organization of more than thirty thousand engineers has been built up, almost over night, to inventory the resources of the entire country The State Directors and their Field Aides work under the direction and guidance of the Committee on Industrial Preparedness of the Naval Consulting Board. The greatest possible latitude is given to each State Board in handling its own affairs. In this way, the brains and ability of those very men responsible for development in every line of industry in this country can be most fully utilized. The general scope of the scheme as outlined by the Committee on Industrial Preparedness will be followed by all, and will cover all classes of industries and the principal mines. Detailed methods of carrying out the plan differ somewhat in the different states.

It was thought at first that some thirty thousand large manufacturing establishments would be inventoried. It now looks as if the number would not be far short of eighty thousand, and, in fact, might exceed that figure. The extent to which the smaller establishments were to be covered was left to the discretion of the State Boards who are most familiar with the local conditions in their state. Some State Boards have divided their work into counties and appointed a Chief Field Aide for each county Others have divided the states into four or five sections and each member of the State Board is responsible for the work in his section. Others, where the local industries of the state are such as permit, have divided the work on the basis of the class of industry The best method to fit the local condition has been chosen in each case.

All the engineers comprising this great army of trained men work without pay and meet their own expenses. The inventory form was carefully prepared with the aid of the army and navy, the engineers, the manufacturers, and all who might presumably have valuable suggestions to offer This form does not call for intimate information. However, in spite of the fact that the information is not what is ordinarily considered confidential, all possible precautions have been taken to see that it is held rigidly confidential, and the caliber of the men behind the movement is such that the manufacturer can feel well assured that the information he furnishes will be used as intended exclusively for the benefit of the army and navy As the completed inventories are received in the office of the Committee on Industrial Preparedness, such items as can be tabulated and summarized are punched on a tabulating card so that all possible significant summaries can be readily made for the entire country by means of mechanical tabulating machines.

The inventory form provides for such data as the physical characteristics of the plant; ground area, floor space, number of stories; whether stories can be added; source of heat, light, water, power; whether the facilities for feeding and housing employees are ample if large addition is made to the force, etc. In general, the information given under the heading of "Plant" shows completely the present physical characteristics of the plant and the possible opportunities for expansion. Under "Manufacturing and Production" such questions as those bear-

ing on the tool equipment idle in slack season, the limits of precision in machine work, the principal materials used and where purchased, and the principal products manufactured, are asked. Each question has been carefully considered and there is a definite reason for it. For instance, if a given concern has a normal yearly slack season, that would probably be the time of the year when it could make the small educational order to the best advantage The questions are asked as to whether the establishment has ever made army and navy goods for the United States or foreign governments, and whether it has facilities for the construction of jigs and tools. Under the heading of "Labor," the questions cover general labor conditions, the number of skilled men in the shop, the number of unskilled men and the number of tool makers, the number of women in the shop and in what numbers women can replace men if absolutely necessary, and the approximate percentage of employees who are not American citizens.

Under "Transportation," trucking distance, quality of street service en route to shipping point, number of trucks owned and hired, shipping facilities by water, etc., are subjects of interrogation.

Each manufacturer is asked whether he would consider bidding upon regular army and navy contracts in time of peace, whether he would consider accepting army and navy business *in time of war on cost plus reasonable profit basis*, whether he would consider accepting the minimum annual education order, together with payment therefor upon a reasonable basis, and also whether he would favor the enrollment of skilled labor in the "Industrial Reserve" An inventory of "manufacturing and producing equipment" consisting of a summary of classes of tools and types of machinery, is called for This inventory will assist in the determination of what specific class of army and navy goods, out of the thousands used, a concern can probably best make

To aid in the work of the engineers and that of this committee, President Wilson has appealed to the business men of the country in an open letter; the Associated Advertising Clubs of the World, in cooperation with the publishers, are placing free of charge full page advertisements in magazines and newspapers throughout the country announcing this nation wide, wholly non partisan, organized movement, national bill posting interests are placing on the billboards throughout the country graphic posters explaining the work and appealing to the public for coöperation Neither the advertising men the artists nor the bill posting people will accept pay for their labor and the expression of their talent. The moving picture men are doing what they can gratuitously to help educate the public. The newspapers in their news columns and editorials are assisting enthusiastically In the various states, land lords have given offices free, furniture companies have patriotically loaned furniture, large corporations have assisted in providing clerical help, Mr Coffin, as Chairman of the Committee, is devoting his entire time to the work of the Naval Consulting Board and his associates in the Hudson Motor Car Company are glad to have him do it. The American Telephone and Telegraph Company has patriotically permitted me to spend my time on the work. The offers of free help and assistance from manufacturers, business men and professional men throughout the country are inspiring A definite, concrete, important task is being accomplished promptly and efficiently through patriotic motives alone Can the by products of such a mobilization of good will be over-estimated?

Our New Industries

(Concluded from page 586)

for foreign devices. One concern even reports that it has been doing a good business in England, Australia, and South America. The buyers from abroad have been very well satisfied with their dealings with American concerns so far. There is only one thing that the manufacturers are objecting to and that is the high prices that they have to pay for materials. Otherwise the toy makers are satisfied with the most prosperous times they have ever experienced.

In addition to these headliners, many American industries have benefited in smaller degree by the shortage of European supplies. Thus, as a direct result of the difficulty of getting tin from the usual European sources, the American Smelting and Refining Company has erected a smelter at Perth Amboy, N J, to handle Bolivian tin ore In the past we depended entirely upon European or Straits Settlements smelters for our supply of tin, amounting to 45,000 tons annually, and never attempted to import the ore and smelt it ourselves. The Perth Amboy plant is designed to handle eventually 15,000 tons a year or about half the Bolivian output. This not only means the establishment of a very important new industry in this country, but will also bring us in much closer touch commercially with some of our Latin American neighbors. I am glad to say that the Bureau of Foreign and Domestic Commerce was able to assist in the negotiations that led to contracts with the Bolivian miners.

The manganese ore and metal industries have been affected by the shortage of foreign ores, yet the American production has not increased so rapidly as might have been expected The production for 1915 is thought to have reached 6,000 tons, as compared with 2,635 tons in 1914 Much preparatory work has been done at mines in Virginia Tennessee, Colorado and California, and a larger production is expected in 1916 The shortage of high grade ores for use in manufacturing flint glass and dry batteries has been keenly felt. Efforts are being made to conserve during refining the manganese contained in raw pig iron, thereby reducing the amount of ferro-manganese that must be added to make steel

Invar metal, an alloy of nickel and steel, valuable for instruments of precision because of its low coefficient of expansion, has never hitherto been manufactured commercially in this country, our supplies having come directly or indirectly from France Of late this has been the cause of considerable delay The United States Coast and Geodetic Survey is informed that an American manufacturer is now prepared to furnish this material in any quantity desired

The American imports of ichthyol, an Austrian pharmaceutical product, distilled from fossilized fish remains, which has a very important use in medicine, were of course cut off by the war In a comparatively short time a St. Louis firm put upon the market a very acceptable substitute.

An American industry with a $1,000,000 market has come into existence as a result of cutting off the imports of petrolatum from Russia By the end of 1914 at least a score of American refiners were experimenting in the new field and at least ten sources of domestic white oil for medicinal use were soon developed These new American medicinal oils are quite equal to the Russian product and will probably hold the field permanently

Bromide papers for photographic use have been largely imported from Germany in the past and the sudden demand for bromine for use in making this paper found the American supply inadequate Recently the old wells in and about Pomeroy, Ohio, and Mason City, West Virginia, have again been put into active commission. This, in connection with the regular output from Michigan and Pennsylvania, will soon enable American manufacturers of bromides to meet the normal demands of domestic consumption.

The war found us unprepared to manufacture enough lanolin, or refined wool grease, to meet the demand. Ordinarily we import about 12,000,000 pounds of crude wool grease and 2,500,000 pounds of lanolin. The domestic production of crude grease is about 6,000,000, but very little lanolin has ever been made at home. We have always used up the crude grease in tanneries, cordage factories, etc., and left to others the work of preparing the refined wool fat so valuable in salves, [illegible]

[illegible] works that once merely dabbled in lanolin are taking up the work seriously

Previous to the war the better grades of filter paper were supplied almost exclusively by Europe. All grades of such paper are now produced at home, including the very best products

A well known St. Louis fur concern is already dressing and dyeing 10,000 seal skins in its present building, using a method formerly employed only in England, and is expanding its plant This is one result of an agitation for an American fur industry that began soon after the war started The United States is the largest producer of raw sealskins in the world, and it is also the largest consumer of finished seal furs This would seem to make it natural that it should sell its own sealskins and dress and dye its own furs It never has, however We have in the past sent our raw sealskins to London, paid London for dressing and dyeing them, and brought them back, paying duty double and transportation charges This added 52 per cent to the price of the raw skins The Department of Commerce took the first step to end this when it held the first sale of raw sealskins ever held in this country It was a success, and has led to the permanent establishment in America of a new industry In the last year there have been several successful fur sales in this country, in St. Louis and in New York.

During the last year there has been introduced into this country the chemical porcelain industry, with the help of the Bureau of Standards Two years ago there wasn't a manufacturer in this country who believed chemical porcelain could be made from American materials in American factories Now two establishments here are making the best type of modern chemical porcelain

In the past much of the clay used in this country in the manufacture of porcelains came from England, that for the manufacture of crucibles and other high refractories from Germany, and that required for any other fine products from France Experts in the Department of Commerce have pointed out that clays for all these purposes may be obtained in the United States and by slight treatment be made equal and in many cases superior to the material heretofore supplied by Europe Many of these clays are found in the South, and are beginning to be produced commercially

Manufacturers who use whiting, an essential constituent for certain ceramic glazes and bodies, generally have imported this material from England However, a sample of calcium carbonate submitted recently as a by product by a firm in Baltimore has been found to be an excellent substitute for the English whiting

Until recently all naphtha and gasoline internal ignition safety lamps were purchased abroad Since the war started patents on a number of foreign lamps have expired and there have already been placed on the market several American lamps of this type With the help of the Bureau of Mines there have also been developed several types of permissible electric lamps which are now on the market in competition with foreign makes The best glass chimneys for safety lamps have heretofore come from Germany, but as a result of the war the manufacture of such lamps in this country has been improved, and orders for many thousand such chimneys have been placed in this country by English collieries

A "more sheep and more wool" campaign is one of the newest efforts to expand American industries and it is already bearing fruit. There is no particular reason why we can't raise more wool at home without interfering with other industries and it is thought that a definite reform in this respect has at last been effected.

Novelty buttons have long been imported from abroad, especially from Austria, Germany and France, and several of our largest manufacturers have been giving them the attention recently Some good buttons have already been placed on the market and more are promised [illegible] Americans manu-

facture great quantities of fresh-water pearl buttons and there is an important industry in ivory nut buttons, but the fancy articles manufactured of galolith, celluloid, etc., have come from abroad.

A certain kind of glass in Nebraska was formerly shipped to Germany for use in manufacturing quartz glass for test tubes, retorts, etc. These articles were then shipped back to us at high prices. This glass is now being made in this country and will continue to be made here. Similarly there are now at least four factories in this country engaged in the manufacture of optical glass of a kind that was formerly purchased largely in Europe. These factories report that they are making all the glass they need for their own requirements and some in excess, and it is doubtful whether we shall ever again purchase abroad to the extent we formerly did. In fact, Europe formerly supplied us with large quantities of scientific apparatus of all kinds, but since the war started practically all apparatus of this description is being manufactured by American concerns.

Probably no feature of our recent development has been more satisfying than the growth in the shipbuilding industry Certainly there has never been a time when tonnage was more needed, and American tonnage especially During the first three months of 1916 American shipyards for the first time in many years took a lead over British yards. For the three months ended March 31, American yards launched 173 merchant vessels of 94,464 gross tons while, according to Lloyd's shipbuilding returns, British yards launched 69 vessels of 80,561 gross tons and merchant ships now building or under contract in American yards are approximating the British output for the future

No attempt has been made to recite all the facts available on the subject of the new and expanded industries that have resulted from the war's interference with our accustomed supplies from Europe, but a sufficient number of instances have been mentioned to indicate the range of products that have been affected and the importance of the continued manufacture of such products to the future prosperity of the country The importance of these facts is not that we have been able to manufacture certain articles that we never made in important quantities before—optical glass, dyestuffs potash, dolls—but, first, that there were so many lines for which we were dependent on Europe, and, second, that we are now making many of the things we once thought we could not make and will continue to make them after the war is over

A University to Order

(Concluded from page 583)

fices The use of a flaring nozzle diminishes the velocity of the stream entering the tank, and at the same time is itself a shield against swirls and irregularities of flow in the still water Most of the pumps are cross connected in such a way that the discharge from any or all of them may be used in the hydraulic experiments requiring water under pressure. For the measurement of large quantities of water there are two open tanks 10 feet in diameter and 10 feet tall, fitted with gage glasses and vernier scales, so that the water level may be read with the utmost accuracy Experience with smaller tanks leads to the belief that one man can handle no less than 60,000 pounds of water a minute, this in itself shows the large scale of operations in the new laboratory, and one may readily see that the measurements will be free from that common criticism, "that laboratories work with teaspoonfuls."

The new isolated power house, built on the lines of a big central station, is itself virtually a laboratory, equipped with 2,000 horse-power of boilers and four turbine generators and two motor generators. Alternating current at 2,300 volts and direct current at 110 volts and 220 volts is supplied. The power house also supplies steam for all purposes in the main group, and a subway of reinforced concrete, about 7 feet square and 1,000 feet long, carries the steam mains to the build-

ings and laboratories. For the present a 20-inch pipe will supply low-pressure steam for heating and other service purposes; a 10-inch pipe will supply high-pressure to the laboratories, and a 5-inch pipe will return the condensed water Condensing water for the turbines comes from the Charles River Basin through a concrete main 30 inches in diameter and a quarter of a mile in length, and is returned to the Basin through a similar main.

From these scattered details it is clear that the Institute will open its next academic year with a wonderful physical equipment, representing the last word in the applied science of to-day Probably never before has an institution of learning been able to boast complete up-to-dateness in all its equipment, covering such extensive fields. The Institute trustees must share with Mr William Weller Bosworth, the architect, the credit for this achievement.

Our Present and Future Sources of Vegetable Tannins

(*Concluded from page 581*)

the bark were used for these purposes, in 1915, the amount was about 18,000 tons It is worth from $5 to $6 per cord of 2,240 pounds on board cars at shipping point The amount used is nothing compared to the amount wasted in utilizing the timber for lumber and ties

The reason the bark of eastern hemlock has been used so extensively and that of the western species so little is because the tanneries desiring hemlock are in the East There is still an enormous supply of western hemlock and while its bark is thinner than that of the eastern form, it contains a higher percentage of tannin Analyses show from 15 to 17 per cent of available tannins as opposed to about 13 per cent for Pennsylvania bark and a little over 10 per cent for bark from Quebec That the tannin is of good quality is shown by the fact that in at least one Washington tannery producing chiefly skirting leather for saddles, western hemlock bark is used exclusively The manufacture of hemlock bark extract may solve the difficulty as to freight costs.

The use of sawmill and logging waste as a source of tannin has not progressed very far in this country Some recent experiments at the University of Washington with bark, slabs, and sawdust of Douglas fir (*Pseudotsuga taxifolia*) and western spruce (*Picea sitchensis*) yielded the following results

TANNIN CONTENT OF MILL WASTE

	Douglas Fir					W Spruce	
	Sawmill bark	Sawmill slab	Fresh bark	Cambium layer	Sawdust	Sawmill bark	Sawmill slab
Per cent total solids	14.75	14.92	11.31	21 96	5.78	12.83	11.25
Per cent soluble solids	13.36	13 02	9 36	19.28	4 40	12.30	10 25
Per cent reds.	1 39	1 90	1.95	2 68	1.38	0 53	0 87
Per cent non-tannins.	7.02	7 10	6.74	9 36	3.34	6 42	6 79
Per cent tannin	6.34	5 92	2 62	9 92	1 06	5.88	3 69
Per cent moisture.	9.06	6 91	14 27	20 59	15 51	15 23	9 15

Several skins tanned in Douglas fir extract are reported to have produced a very desirable leather with a color similar to that obtained from oak tannin It is believed that fir slabs containing an average of 5 per cent tannin offer a good material for the tannin extract industry Compared with western hemlock bark at $11.50 per cord, it was found that three cords of Douglas fir slabs yield as much as one cord of hemlock bark, but at less than one half the cost for the bark.

Bark as a by product of the pulp industry is beginning to be used in a small way Another source of tanning materials that has attracted chemists for some time is the waste sulphite liquors from pulp mills This liquor contains a large amount of organic material which, when treated with certain acids and freed of the insoluble lime salts, makes a fair grade of tanning material for use with other tannins. This source offers good opportunities for further investigation and exploitation.

As an instance of the interest leather

manufacturers are beginning to take in the utilization of logging and mill waste, may be cited the investigations which a large shoe-making concern is now conducting in southern New England in an effort to find any wood or bark with fair tannin content which can be bought for less than hemlock bark. This company is looking into the available supply of by products of the lumbering and manufacturing industries, such as bark, slabs, culls, and low grade lumber In this case the success of the undertaking is doubtful owing to the lack of large milling plants in the region and to the fact that the lumbering operations are on a small scale and widely scattered In other regions it should prove entirely feasible

The cones and bark of all our pines contain considerable tannin and this source deserves consideration. It has been found in Europe that leather prepared by the aid of pine cones and bark is equal to that made by the ordinary tanning processes. If the bark of our pines is found suitable for tanning purposes an enormous supply will become at once available

The bark of the basket willows contains sufficient tannin to make these highly desirable for use for certain fine grades of leather Up to the present willow bark has had no market value in the United States, but this condition promises to change As soon as the bark can be had in sufficiently large quantity by tannin extract producers, basket willow growers will find an added incentive to the development of their industry The tannin content of the bark of the willows grown commercially in this country is as follows Purple willow (*Salix purpurea*), 8.75 per cent, Lemley willow, (*S pruinosa*), 6.98 per cent, American green willow (*S amygdalina*), 11 38 per cent

Tannin is a general term for a whole group of substances having certain characteristics in common, the most important of which is the ability to convert hides into leather Comparatively little is known about the chemical composition of even the simplest tannins In many cases each material contains a different variety of tannin, and that from the same plant may be of a different composition, depending upon the part yielding it, as the wood, bark, leaves, roots, fruit etc Hence analyses showing the tannin content of a material are only an indication of the value of that material for tanning purposes In practice it is customary to use various mixtures or blends of tannins depending upon the quality and color of leather desired. Much also depends upon the preliminary treatment of the hides and the details of the processes used in tanning

Tanning methods are mostly the result of experience and the rule-of thumb methods largely employed are in part responsible for the slowness with which new materials are introduced and for the poor results which are so often obtained at first with a new product. It is not so much information regarding the chemical composition of tanning materials that is needed as it is better knowledge of their properties and uses Many tannins in this country may prove of greater value when used in smaller amounts and in mixture with other materials, especially in the production of different grades of leather Instead of depending so much on importations which may at any time be cut off, attention should be devoted to the utilization of our own materials, thereby stimulating new industries and reducing waste in others.

War Game—XII

(Concluded from page 587)

size handled in our problems are preferable.

The War Games have an added interest if they are carried through each stage with exactness and care. Their usefulness, from the standpoint of the participants, will be greater if they understand all the elements which are of decisive character in real war With this in mind the following principles may be laid before the reader:

1. The plan of a war game is but the start of the game.

2. Its developments involve new situations which demand new plans

3 The tactical points of importance are the decisive factors for the coming strategical moves

4. The factors not purely military, but closely connected with the actions of the army, in fact, in many ways depending upon them, should also be considered These are the ammunition supply, the provision supply and the sanitary services The theory of mobilization the railroad and other transportation services on land and water are worthy subjects for the students of the tactical and strategical arts to consider, and there is ample room for their study in the war game

The gist of the problems we have handled in the War Game series are known under the military term "Operations" They are tactical tasks designed to give a clear picture of the actions of independent detachments The only point untouched was the point of Administration

We shall undertake to draw a general sketch of the same

Military Administration

The Administrative Service is divided into two main divisions one is "The Service of the Interior and the other "The Service of the Theatre of Operations"

The duties of the first are to supply the army in the field with everything essential to the carrying out of the task entrusted to the commander Those of the second are to utilize this service and to accomplish the mission assigned, whatever this might be

It is evident that to win a decisive victory, or to even attempt an effective campaign against the enemy in these days of large armies is a very different proposition from the wars of the past century There was a time when an army simply provisioned itself from the enemy's territory, by living off that country Such simple yet uncertain methods belong to a dead age In our days as in Napoleon's time, soldiers fight on their stomachs—today the provisions must be taken along instead of being secured on the ground

This is a necessity and has taught the strategist to figure for his fighting forces a base, from which to operate

A base is a point with railway or boat communications, where a great quantity of war material and supplies are concentrated In the United States army the division is the unit which is provided with ammunition, supply sanitary and engineer trains Detachments smaller than a division when operating independently are provided with similar organizations

The consequence of the great size of such organization is its limited mobility as soon as a first class railroad service is left behind The farther the division has to operate from a railroad, the more difficult it will become to hold the line of communications A line of operations behind which a parallel line of railway runs is the ideal, unless direct lines leading to each division can be had

The accompanying illustration showing the military and Administrative operations of three divisions will give a clear idea of the working of the military machine

Answers to Questions in War Game XI

Question 1 At 2 40 P M General G was in the Sherwood Field Club, from where he observed the naval developments He will remain, for the time being, inactive

As we have seen, he has occupied with one regiment of cavalry Sherwood Hill placed the 5th Regiment of Infantry as reserve, in readiness behind the Southern slope of the hill The 1st Battery which marched out with the cavalry, was placed behind point 67 out of the enemy's sight The 2nd Battery will remain with the Infantry

The remaining forces in Pottstown are still in readiness to be moved forward

The reason for this seeming inactivity is the fact that until the enemy has shown his own designs, the very best thing for the detachment commander to do is to hold his forces together In this way he

will be able to meet the enemy wherever he may undertake to land.

Question 2. The 2nd Coast Battery, consisting of four 3-inch rapid fire guns, is in position on Peck Hill. This battery remained inactive for the reason that its guns would be helpless against the 12-inch guns of the enemy cruiser

By not firing, this battery has remained a very serious menace to the transports. As the developments of the War Game have disposed of the enemy cruiser, this battery will be a trump in the hand of the commander

Question 3 The battery will remain silent until the enemy cruiser is sunk.

Question 4 Fully answered in the accompanying plan

Question 5 At 6 15 P M the field battery located behind point 67 will open fire on the two enemy transports.

Question 6 General G, having fully realized at 5 P M that the enemy has decided to land on the southern edge of Murphy's point where the deep water permits a close approach to shore, was ready to put his plans into the form of an order

Through his field glass he was able to observe that each transport was carrying a regiment of Infantry of four battalions each, a battery and machine gun company Therefore, he was facing two regiments of which only the first men have reached shore.

The landing of the batteries would prove a considerable task. Hours would have to pass before these batteries would become a serious menace But an overwhelming artillery force consisting of the cruiser and the four torpedo boats' guns must be taken into consideration.

At this time, the Blue forces have revealed only the Coast Battery on Wyola Hill and these were silenced by the superior fire effect of the cruiser

It is plain notwithstanding the fact that the Blue Detachment of General G is superior in land forces the enemy's artillery overbalances this advantage

Therefore, General G's decision must be of defensive nature, with the intention of equalizing the artillery situation This can be done by simply waiting for further developments and if the Blue navy should fail to improve the situation, to retreat out of range of the enemy's gun fire.

His order would be

"Sherwood Hill, July 17th, 19—, 5 P.M

"The enemy has succeeded in entering Nehaminy Bay with one cruiser, four torpedo boats and two transports One enemy transport was torpedoed near Thompson's Island and was beached there and troops landed on island

"The other transport is landing troops at Murphy's Point

"We will defend Sherwood Hill.

"The Battalion of Engineers and the 6th Regiment of Infantry will establish a second defensive line on MODENA HILL parallel with the DEANSVILLE GREENVILLE ROAD

"Signal service between Modena Hill and Sherwood Field Club to be immediately established

"The Hatfield Alpine R. R. will remain open for hospital trains Temporary dressing station at Schulz farm house.

"I shall remain on Sherwood Hill"

The Result of the Operations

As soon as the Red Cruiser was sent to the bottom of Nehaminy Bay the situation for the Blue forces became better balanced, and naturally the preparations which were made to get out of the effective range of the cruiser were all disregarded.

The Blue artillery, in its full complement, will immediately go into action and the other forces will attack the enemy

The torpedo boats of the enemy, with two 3-inch guns, each, will still be very effective, but even so, the chances are good to overwhelm the land forces. Those on Thompson's island are already hors de combat and with a forceful offensive and the transports disabled or sunk, the landing effort of the Red forces would be defeated.

THE END.

Plain Facts About Kerosene Carburetors

(Concluded from page 585)

a similar member for kerosene on the other side The plan of operation was to start on gasoline and to run on kerosene only when the retort carried in the center of the heating chamber became sufficiently hot to vaporize the kerosene This retort communicates with the main mixing chamber by means of three pipes. The main air entrance is on one side of the mixing chamber and directly in line with it on the other side, and not shown in the illustration is the outlet to the engine The retort is heated by passing exhaust gas through the heating chamber around it

The instrument at Fig 4 is a double carburetor also having two float bowls Each of the float bowls includes a single jet chamber with a separately adjustable needle valve in each jet and a single throttle chamber and valve One chamber is for gasoline, the other for kerosene, and in practically all respects they are duplicates of each other Each chamber contains a weighted air valve, to which is attached an adjustable graded fuel regulating needle so that any displacement of the air valves affects the fuel supply, because the needle is raised out of the jet when the air valve is lifted The edges of the air valve seat on a ring having angular walls The spray nozzles do not supply the fuel directly into the mixing chamber but are located in small diameter choke tubes The throttle chamber has rectangular ports communicating with the gasoline and kerosene mixing chambers The movement of the throttle slide is partly rotative and it is also capable of some degree of reciprocation this movement being against the tension of a spring By moving the throttle sleeve laterally it is possible to connect either mixing chamber with the engine or to run partly on one fuel and partly on another This device is an English invention

Mention has been previously made of the desirability of heating the kerosene vapor to insure a proper gasifying influence Various methods are followed to attain this end The most common system is undoubtedly that shown at Fig 5-A in which exhaust gas is caused to flow through a chamber surrounding the Venturi tube which acts as a mixing chamber In this device the air inlet is supposed to be coupled to an air stove attached to the exhaust manifold so that warm air will be inspired Of course the exhaust gas circulating around the Venturi, heats that member and as the holes in the spray nozzle through which the fuel is atomized are located very near to the walls of the Venturi tube the fuel is heated as it is sprayed out At the same time it is broken into a fine mist on account of the speed of the air stream passing through the restricted area of the mixing chamber It is necessary to start an engine equipped with this carburetor with gasoline and when the parts are sufficiently heated a simple two-way valve at the bottom is turned so that communication is possible between the kerosene float chamber and the spray nozzle

A kerosene carburetor known as the Chambray is shown at Fig 5 B The mixing chamber is concentric with the float chamber and is generally similar in the main details to other standard float feed carburetors. The fuel level is regulated by the float so that it lies about one sixteenth of an inch below the top of the spray nozzle. When the engine is started a primary air supply is drawn into the chamber surrounding the spray nozzle This passes up through the pipe just above the spray nozzle at high velocity and of course draws up a supply of liquid vapor with it The amount of liquid depends upon the position of the needle valve, which in turn is regulated by a cam member that works in conjunction with the air throttle. A valve regulates the primary air supply and maintains a high velocity of the air so that it is thoroughly mixed with the incoming fuel. From this point the mixture goes into a tube which is placed in the exhaust manifold or

which may be carried in a supplementary heating chamber in connection with the exhaust. The gas is heated in this tube prior to entering the mixing chamber. The richness of the gas is regulated by the amount of air admitted through the secondary air inlet. While in the illustration only a short length of tube is shown, in actual practice about 5 feet of tubing is coiled in the exhaust pipe.

The carbureting device shown at C Fig. 5 not only depends on thoroughly heating up the mixing chamber but also breaks up the fuel into very fine particles by having it flow through a series of passages between the main air cone and the mixing chamber walls. There is a mechanical inter-connection between the throttle valve and a needle regulating the flow of liquid from the float chamber to the fuel passages. The auxiliary air valve is a peculiar cone shape member so shaped as to assist in breaking up the fuel sprays. Two float chambers are provided, one for gasoline for starting and one for the kerosene. A simple control lever operates the valve at the bottom that connects either of the fuel chambers with the fuel passages.

One of the difficulties advanced against all types of kerosene carburetors is that it is practically impossible to start these cold. The instrument shown at Fig. 5-D employs two sources of heat. A heating or resistance coil designed to be operated by starting battery current is put into operation only when the electric starting motor turns the engine over. The upper heating member through which exhaust gas passes is intended to complete vaporization. A feature of the device is a mechanical atomizer in the form of a rotating vane member which is intended to divide the liquid fuel in fine mist. It is stated that by the use of the electric heating coil that the gas is sufficiently heated to start a cold engine on kerosene.

A number of carburetors have been devised for kerosene and other heavy oils in which a part of the fuel is burnt and the resulting incomplete combustion is depended on to vaporize the remainder. The carburetor shown at Fig. 6 is the subject of a recent English patent and was described in the late issue of the *Automobile Engineer*. This is a partial combustion type and its main feature is that a rich mixture from the neighborhood of the spray nozzle is made to pass through a trap chamber in which the incomplete combustion takes place, from which it goes to the throttle chamber where it is diluted with auxiliary or extra air. A series of gauze screens which limit the scope of combustion are placed between the trap chamber and both the throttle chamber and spraying nozzle compartment. The air which enters through the primary air inlet travels upward by the spray jet and it must pass through the trap chamber before it can reach the mixing chamber. The fuel passes through a series of gauze screens into the trap chamber where a spark plug of the conventional pattern starts the combustion when the engine is first cranked over. A spark is deflected from either the magneto or ignition distributor until the rich gas catches fire, after which a sufficient heat will be present to maintain combustion in the trap chamber. Above the horizontal screens at the top of the trap chamber is carried the supplementary air inlet. The total air supply from both the primary and auxiliary air inlets is controlled by a weighted valve, which, of course, is under the influence of the engine suction. It is a disadvantage that a certain amount of tarry deposit collects on the gauze screens so these must be arranged so they may be easily removed for cleaning and replaced when clean.

It is also found that a certain amount of the residue due to the incomplete combustion collects at the bottom of the trap chamber and it is desirable for this to be drawn off from time to time or in some cases continuously. One of the patented features is a trap device which consists of a paddle wheel between the blades of which a number of recesses are formed. Only one of the recesses is exposed to the trap chamber at a time and the de-

posit settles in this. By rotating the paddle wheel it is evident that this chamber may be emptied when it registers with the bottom opening and a fresh one brought into position. The rotation of the paddle wheel may be obtained gradually by simple ratchet and pawl mechanism driven from the engine.

This type of carburetor performs well in actual operation as was attested by a practical demonstration given the writer by a New York inventor of a device of this character. This was fitted to a standard touring car and was easily started by cranking in a customary manner without the use of gasoline. The engine seemed to have the usual flexibility, ran smoothly and "pulled" well. The only objection that could be advanced was a slight haze and odor in the exhaust. No figures were available giving the efficiency of this device, but it was said that a very small percentage of the fuel was consumed in the trap chamber in proportion to that made to do useful work in the engine.

Summing up, it will be evident that the use of kerosene as fuel in automobile engines will not become general until gasoline prices become considerably higher than at present. Kerosene is not used abroad where gasoline sells for twice the average price prevailing in this country even in normal times. The motorist will have to be educated to tolerate the disadvantage of kerosene carburetors which will only become possible when their advantages are greater than the disagreeable features incidental to their use. For stationary, agricultural and marine purposes, kerosene engines are practical and widely used. The Diesel type which has not been discussed because it is not a suitable type for automobiles, will utilize all the fuel oils and is very efficient in the foregoing applications.

The Technically Trained Foreman

(Concluded from page 577)

visit some place where the processes may be seen in operation. A distinct effort should be made to acquaint the student with the mechanical and technical processes, to impress him with their importance and to get him interested in them so that he will want to do these things himself, but without allowing the theoretical and scientific side to suffer.

With the increased demand for practical education which would result there would be many schools ready and anxious to take up the work where the high school would leave off. We would find many courses established throughout the country where the aim would be to train young men specifically for the responsible positions in chemical manufacturing plants outside of such positions as would be designated under the head of chemists. By the establishment of such courses, which of necessity would be of shorter duration than the average college course, it would be found that hundreds of young men would be looking for just such opportunities—men who now are excluded, not so much by lack of elementary preparation as by lack of finances and time for the ordinary four year college course.

That the above conditions exist was felt by the institution with which the writer is connected, and as a result, in 1905 a course was established which has for its aim the training of young men for foremanship positions in chemical industries. A large part of the instruction consists of carrying out manufacturing operations in a series of model plants. On former occasions the writer has gone quite fully into detail regarding these manufacturing plants. It might be mentioned, however, that in these model plants during the past year quite a volume of material has been converted into finished products. It may also be of interest to note that in the first class to take this course only eight came for that purpose, the remainder being taken from men who had applied for other training. For the past three years, however, over one hundred young men have applied annually for the course, of which number only thirty-five can be accommodated.

Of the graduates from this course over

60 per cent are holding positions ranging from foremen to assistant superintendents, superintendents, and even managers of industrial plants. The remaining 40 per cent are employed mostly in laboratories, although a few are acting as salesmen, and a very small number have gone into other lines.

The question of salary is one that is often asked and may be answered as follows

Starting with the first class of sixteen graduating in 1907 and including the class of fifty four graduating in 1915, the combined salaries of all these graduates amount to the sum of $845,800 per year, the smallest salary being received at the present time is $680 per year, the largest salary is $11,500 It needs no further elaboration to show that the time devoted to such work has not been spent in vain

As an outgrowth of this course in Applied Chemistry, one branch of manufacturing, namely, the Tanning Industry, through its organization, the National Association of Tanners, is coöperating with Pratt Institute in giving two courses of training which prepare young men especially for that branch of industry One of these, the Tanning Course, fits the men for positions of foremen or heads of departments, and is filled almost entirely by promising young men sent from the various tanneries The other, known as the Applied Leather Chemistry Course gives young men who have already had a thorough chemical training a better idea of the practical side of the industry so that they may become more efficient leather chemists

As a result of what specialized training has done for this particular industry and as an indication of the wide awake policy pursued, the National Association of Tanners have recently adopted a plan for the establishment of a Research Laboratory to be conducted in conjunction with the now existing tanning courses This recent development emphasizes very strongly the point which has been raised by others and corroborates the writer's claim, that when we have properly trained foremen and superintendents the industries will then receive and appreciate the full benefit to be derived from the knowledge of the research chemist, and in so doing the higher ideals of the universities and the technical schools will be realized

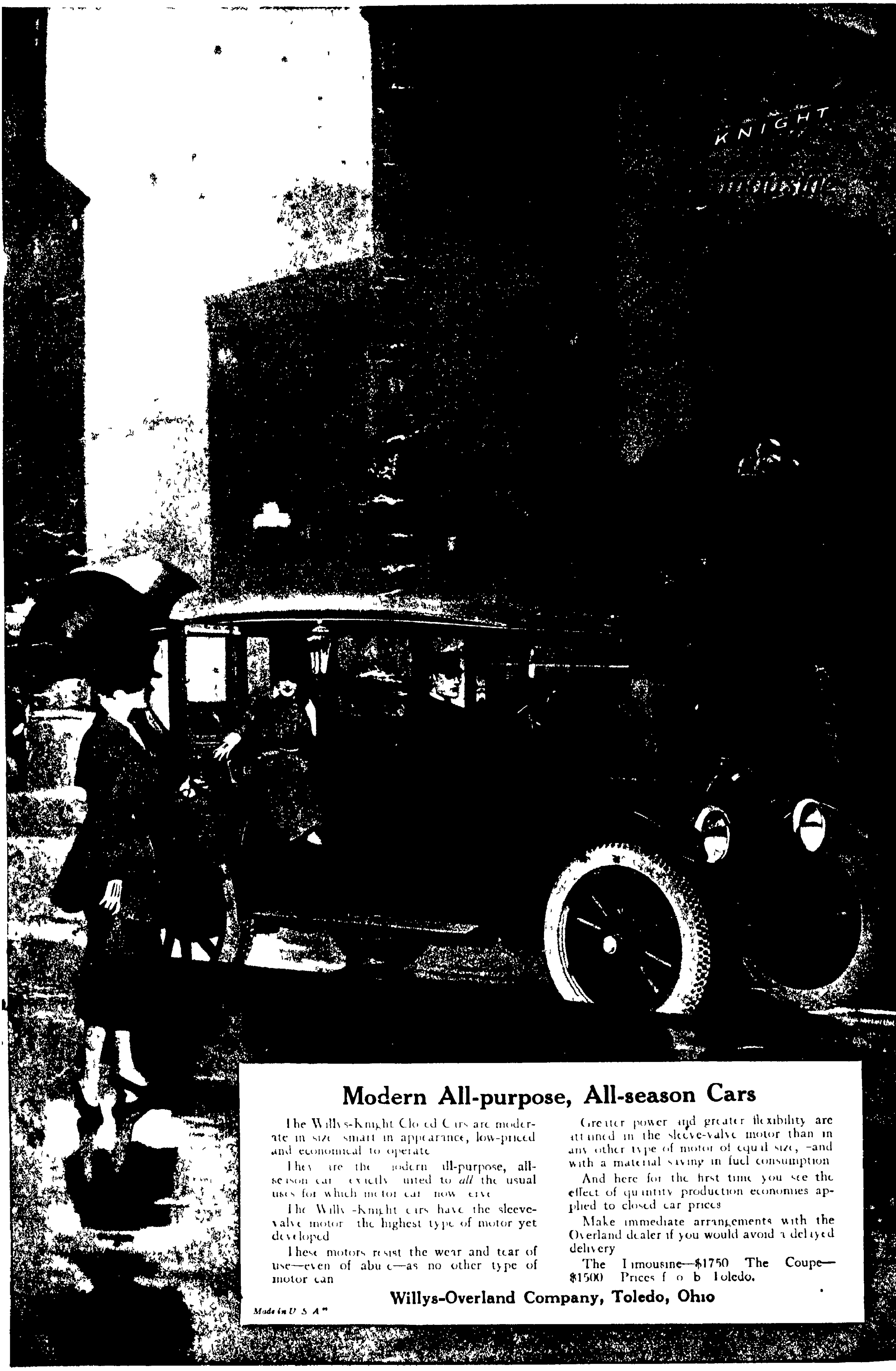
NEW BOOKS, ETC

THE AVOIDANCE OF FIRES By Arland D Weeks New York D C Heath & Co, 1916 16mo, 128 pp, illustrated Price 60 cents net

The reduction of waste by fire is no small part of the large question of conservation of resources. Seven states already require the instruction of pupils in the prevention of fires. Some hundred and fifty common causes are tabulated in this text book many of them indicating inexcusable carelessness. The schools may render a great service to the nation by inculcating the habit of carefulness in children and Prof Weeks's little manual presents its information in such a form that it cannot but be interesting to the children and helpful to the teacher

MECHANICAL TECHNOLOGY Being a Treatise on the Materials and Preparatory Processes of the Mechanical Industries By G F Charnock, M Inst C E, M Inst Mech E. New York D Van Nostrand Company, 1915 8vo, 685 pp, illustrated Price, $3 net

This is a valuable contribution, dealing with the application of science to industry All manufacturing operations are based upon either chemical or mathematical principles, and it is the latter principles that are discussed at great length and with much thoroughness by Prof Charnock He brings together in one volume information that would otherwise have to be sought for in scattered treatises addressed to the expert, and he imparts this information in terms that are intelligible to the majority of workers in the mechanical industries. By a careful study of the work, even the beginner may acquire with small time expenditure a fair knowledge of the production and properties of the chief materials of construction, and of preparatory processes, whether the latter depend upon fusibility or upon malleability and ductility The methods of the rolling mill and the foundry, too often neglected by the young engineer, are here made the subject of close attention and careful explanation. The author's first-hand study of well conducted establishments introduces an element of efficiency that the work might otherwise have lacked.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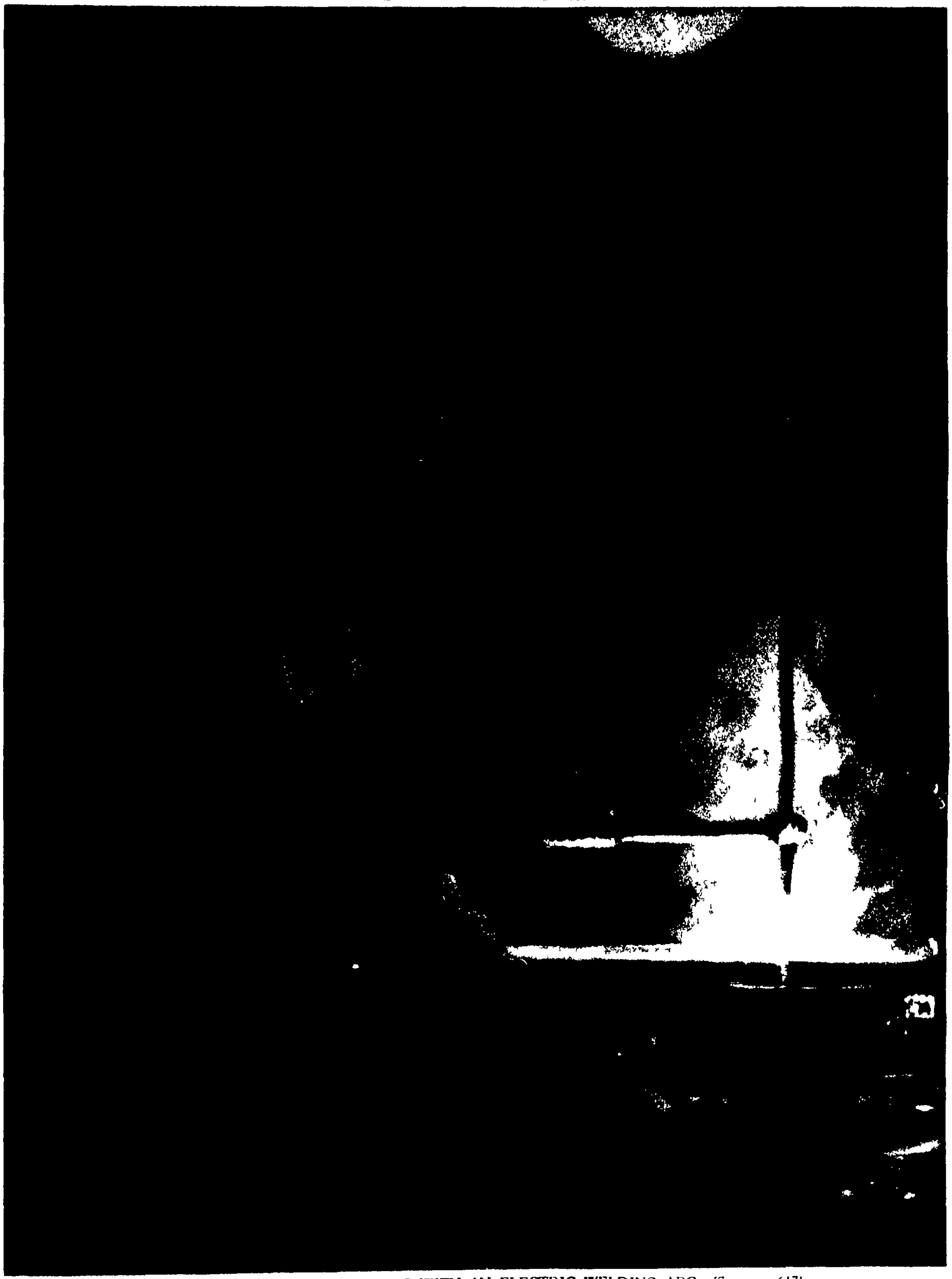

BONDING STREET RAILWAY RAILS WITH AN ELECTRIC WELDING ARC.—[See page 617]

June 10, 1916

Munn & Co., Inc., Publishers
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SEVENTY-SECOND YEAR

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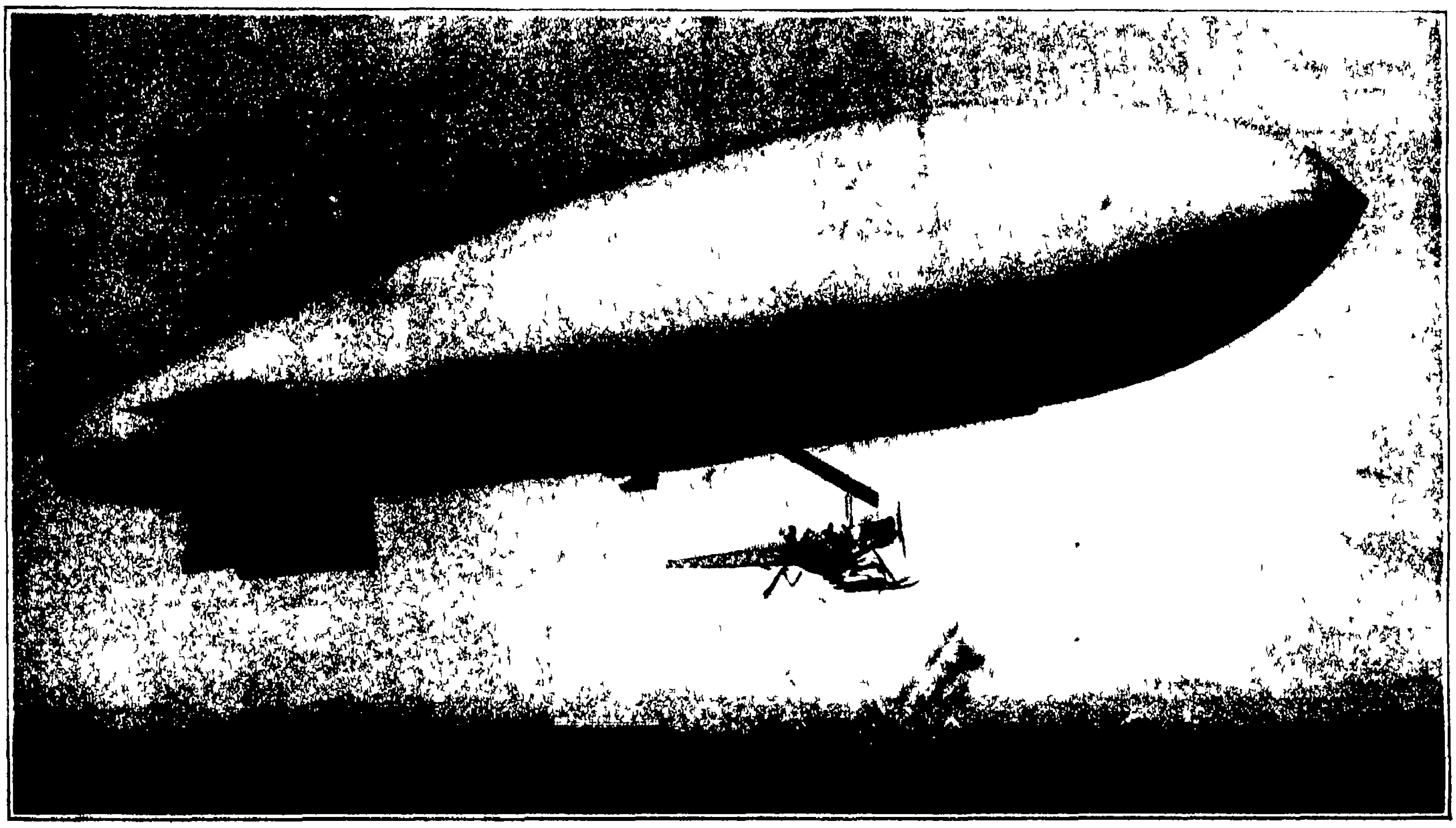


One of the new British scouting dirigibles starting on a reconnaissance flight over the enemy lines on the Balkan front

A Novel British Airship

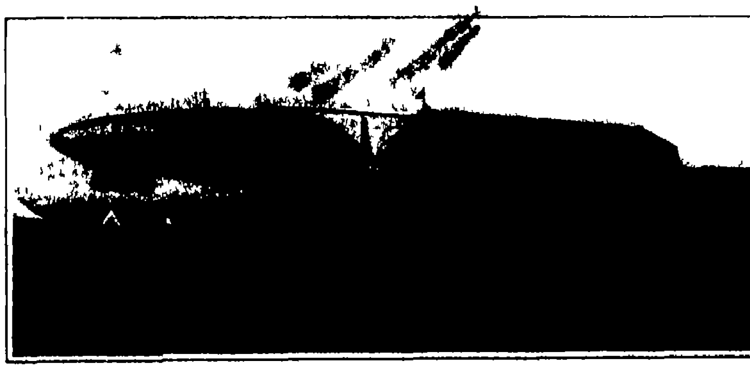
By Baron Ladislas d'Orcy

THE dirigible represented herewith is one of Great Britain's small scouting airships, which have been provided for in the new British aerial construction program for 1916-17. This program is said to comprise the laying down of 50 air ships of both the rigid and non-rigid types, the construction to be completed within two years.

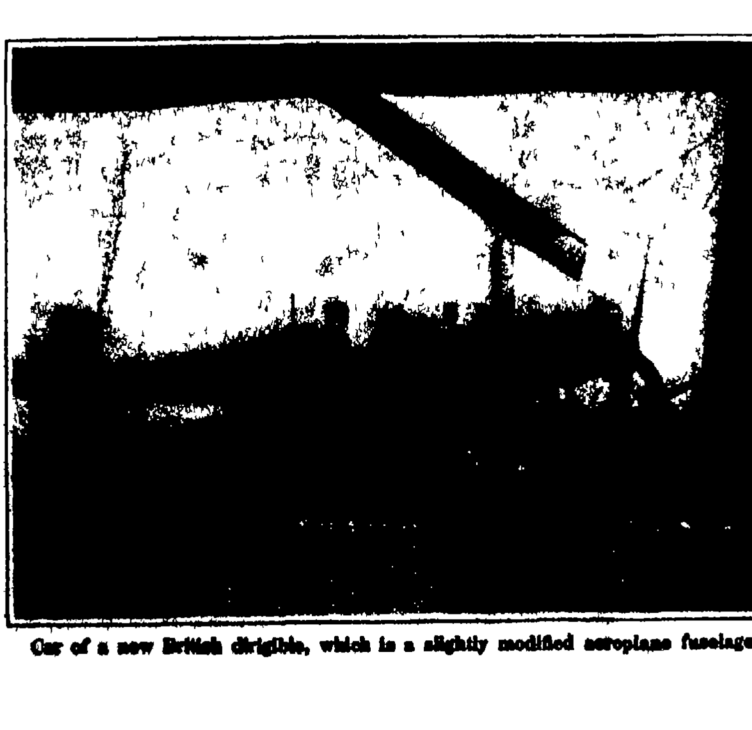
The airships of the type shown in the accompanying illustrations are comparatively small craft and their range is naturally a limited one, they are, however, capable of a great speed which makes them particularly desirable for scouting.

A unique feature of this dirigible is its car, which is constituted by an ordinary fuselage of a British army aeroplane, complete with its engine, tractor air-screw and landing gear, except for the wheels. This disposition is very commendable, particularly for small airships, as it advantageously does away with the heavy car, which, with its elaborate engine mounting and propeller transmission, greatly reduces the useful load and also creates much head resistance, harmful to the vessel's speed.

In the latter respect the design of this airship seems remarkably efficient, head resistance being cut down to the possible minimum, there being, in fact, but two stream-lined bodies (envelope and fuselage), connected by a simple suspension. The excellency of this design also accounts for the relatively small power plant, which is constituted by a 70 horse-power, [illegible] Renault engine, driving a tractor screw. The speed airships of this class develop is not officially disclosed, but seems to be in the neighborhood of 40 miles per hour, rather more than less.



Light British scouting dirigible leaving its hangar at a Mediterranean base



Car of a new British dirigible, which is a slightly modified aeroplane fuselage

An interesting feature that is entirely novel and shows a persistent thought of simplifying the mechanical devices of this airship, is found in the air blower, which compensates on non-rigid airships such losses of buoyancy that may occur through variations of temperature and barometric pressure. Instead of using an ordinary air blower actuated by the engine, the designers of this airship utilize the "slip stream" of the propeller, i. e., the air thrown back by the latter. For this purpose the envelope's "neck," through which air may be pumped into the compensating ballonet, has its aperture placed right behind the propeller, the amount of air admitted into the ballonet being regulated by a valve. Besides its great simplicity, this arrangement strongly commends itself on account of the amount and driving power of the air that thus becomes available for compensating losses of buoyancy in the gas bag of the airship.

Although their work has been less spectacular than the operations of German Zeppelins, the non-rigid and semi-rigid airships of Great Britain and France have proven very useful for night raids on enemy encampments, and, in connection with naval warfare, for harbor defense and coast patrol work. According to the *Echo de Paris*, the mobile forces of every French naval port now comprise, in addition to destroyers and submarines, two small non-rigid airships. These are chiefly used for detecting enemy submarines, and are said to have given an excellent account of themselves.

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The object of this journal is to record accurately and lucidly the latest scientific mechanical and industrial news of the day As a weekly journal it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns especially when such articles are accompanied by photographs

What is Adequate Naval Preparedness?

A CORRESPONDENT asks us to state what is meant by adequate naval preparedness and we propose to answer that question by pointing to actual conditions as they once existed and as they now exist in the navy of the United States To begin with, let us ask first Was there ever a time when the United States navy was adequately prepared? and secondly Is the United States navy adequately prepared to-day? The answer to these two questions involves a comparison of conditions in the year 1905 and 1916 and the comparison proves to a demonstration that we were as completely prepared in the first named year as we are inadequately unprepared to-day

It is, of course impossible within the limit of space at our disposal to go into all the details of the condition of our navy in these two periods and therefore we shall confine our comparison to the question of strength in ships and guns What do we discover? In 1905 our navy as the result of the lessons of the Spanish War and the patriotic liberality of Congress had risen during the preceding six or seven years to the commanding position of second naval power in the world. That our rapidly attained rank was beyond dispute is shown by the fact that the third power in rank which happened to be Germany was far behind us both in the number of her battleships and in the power of her main batteries, for in 1905 the main fighting line of the United States navy consisted of twenty five battleships, as against Germany's twenty and the total muzzle-energy of all guns in the United States battleline was a little less than four million foot tons whereas the total energy of all the guns on the German battle line was considerably less than two million foot tons

Now these figures which are based upon the most authentic records if they prove anything at all prove just this That in 1905 the United States in holding the position of second in naval strength possessed a superiority in its first fighting line of twenty five per cent in ships and over one hundred per cent in gun power over the third ranking naval power which in that year happened to be Germany

That is what we call a condition of adequate preparedness, and it was adequate because our fleet, numerous powerful carrying unusually heavy batteries, and operating within easy reach of its bases would have been more than a match for any fleet that Germany France Austria or Italy could send across the Atlantic Ocean. We make no mention here of the British fleet for the reason that in her possession of Canada Great Britain has given hostages to fortune, and in the nature of things is almost as much committed to the defense of the Monroe Doctrine as we are ourselves. In fact the London Times commenting upon a suggestion that England in return for certain European concessions might forego her active support of the Monroe Doctrine stated that the thing was unthinkable and ended its comment on the matter by saying If the United States possessed no Monroe Doctrine, Great Britain would have to formulate one of her own"

Adequate naval preparedness then means for the United States the possession of a fleet so strong and efficient that no hostile nation could cross the Atlantic or Pacific Ocean and attack with any hope of success.

For illustration of a state of naval unpreparedness it is sufficient to quote by way of contrast the statistics covering the status of the second and third naval power for the year 1916, for to-day the conditions have been absolutely reversed. Germany has moved up from a poor third to a commanding second position whereas we have not only dropped into the third position but that position is shared jointly with us by France, which is about equal to us in its number of first-line battleships, and is greatly superior to us in the strength of its personnel, that is to say, in the number of its officers and men.

Comparing the two fleets then, under their reversed positions we find that to-day Germany's first fighting line includes twenty six ships the total energy at the muzzle of all guns on those ships being over thirteen million foot tons as compared with the United States first fighting line of only twelve ships actually completed whose total gun-energy is something over seven million foot tons or a little over one half that of the German fleet So that to-day the situation is that there is one fleet that of France, which is about equal to our own and there is another fleet which possesses in its first fighting line twice as many dreadnoughts mounting over twice as many armor piercing guns whose total energy is nearly double that of our own fleet. That is what we have in mind when we state that the United States navy to day is in a condition of very alarming unpreparedness

Thus far we have been making our comparison on a basis of material—ships and guns—and we have found that on this basis the fleet which a decade ago was a poor second to our own, possesses to-day a one-hundred per cent superiority This is bad enough, but our unpreparedness becomes shockingly apparent when we state that the United States navy, for war purposes, is short over thirty thousand men and over two thousand officers What this means is best told in the report of the minority members of the House Committee on Naval Affairs —" To provide says the report full complements for all dreadnoughts predreadnoughts cruisers, scouts destroyers submarines and the necessary auxiliaries now in the navy or that will be during 1917 will require 82 762 men or approximately 31 000 more than the present authorized strength of the navy This number of men 82 762, required on a war basis does not include 10 015 men required for merchantmen scouts and other auxiliaries needed in the service in time of war nor an additional 10 000 men to man mine sweepers patrol boats and smaller craft

Now let us get the full significance of these figures firmly fixed in our minds Our navy is now manned or rather undermanned by 52 000 men In the opinion of the General Board which is composed of the ablest officers of our navy it should be manned by 82 762 men to render it efficient That the great fleet, which has taken from us the second position is at all times properly manned, goes without saying and to-day, with nearly two years of war conditions behind it you may be sure the personnel—the officers and men—have been trained to a high pitch of efficiency

Remembering that the question of naval preparedness is relative that a navy is prepared or unprepared according as it measures up to or falls short of, its ability to uphold the country's policies and prevent the outbreak of hostilities by offering a fighting line so strong as to discourage aggression—remembering these things we do not hesitate to say that the United States navy in spite of the excellence of its ships and guns and the high quality of its personnel is as completely unprepared in the year 1916 as it was fully prepared in the year 1905

Our Opportunity in the Antarctic

THE only party of polar explorers from this country now in the field, the Crocker Land expedition, is expected to return home during the present summer Meanwhile, our British cousins, not withstanding the distractions of the war, are represented in the Antarctic by the two branches of the Shackleton expedition, and in the Arctic by the two branches of the Stefánsson expedition, while a new Canadian expedition, under Captain Bernier, is in preparation Norway is backing Amundsen's forth coming Arctic drift Denmark has provided the means for Rasmussen's exploration of northern Greenland Russian explorers, since the war began, have achieved the splendid exploit of the Northeast Passage All of which suggests that our own polar explorers should look to their laurels, and makes it pertinent to inquire whether it would not be well to revive at this time the project of an American Antarctic expedition.

Such a suggestion is particularly appropriate at a moment when the news is not yet cold of the safe arrival at the Falkland Islands of a part of the Shackleton expedition, and of the definite location of the balance of his party This means much to any prospective American expedition It means in the first place that the work of rescue could be pushed promptly to success or definite failure, and that thereafter the expedition would be under no urge to devote valuable time and effort to this matter It means, too, that there would be no unconscious duplication of the labors of Shackleton, the work could be taken up at the precise point where full reports show the British lieutenant to have left off.

On the other hand, with the seafaring nations of the Old World all seriously handicapped by the war, it would seem especially opportune to revert to the plan, so earnestly advocated by Admiral Peary and others about six years ago, of an American expedition to Weddell Sea. Our country has conspicuously neglected the exploration of the Antarctic ever since the epoch making discoveries of Wilkes, in 1840 Indeed, although American whalers and sealers were among the pioneers in the exploration of the Antarctic seas, and the first to glimpse the Antarctic continent, the only regular scientific expedition we have ever sent to the Antarctic was that of Wilkes

There is still time to organize and equip an expedition before the season of navigation opens in southern seas, i e, about the end of the year Peary estimated in 1910 that such an undertaking would cost from $75,000 to $100,000 per annum A well trained personnel could easily be recruited in this country

Some Aspects of "Daylight-Saving"

THE great war in Europe has been prolific in unexpected by products. Not the least interesting of these is the action just taken by several of the belligerent and adjacent neutral nations to give official sanction to a scheme which, though it originated in England and not in Ireland, disguises its purpose of saving gas and electricity under the name of the 'daylight saving plan" This scheme has been persistently agitated for many years, not only in Europe, but also in America and Australia Innumerable public bodies have passed resolutions in favor of it, and many legislatures have given it serious consideration At least three bills in behalf of its adoption on a national scale were introduced in the British Parliament previously to the one which recently passed the House of Commons. A few scientific men of good standing have favored the project, but the consensus of scientific opinion, so far as expressed, has been opposed to it

The daylight saving plan of advancing the clock one hour on a single date in spring and retarding it one hour on a single date in autumn is the scheme which is being tried in western Europe So far as it applies to countries using standard time it is equivalent to the adoption in each time zone, during the summer months, of the mean solar time of the central meridian of the zone next east of it. Opponents of the plan profess to see in it an abandonment of standard time, but the meridian of Greenwich still remains the foundation of the system

In the United States where winter daylight begins much earlier than it does in England and northern Europe there have been advocates of the still simpler plan of using earlier time throughout the year This idea has manifested itself especially in the adoption by certain communities lying near the boundaries of the standard time belts of the time pertaining to the belt east of them

The whole subject is much more complicated than might appear at first sight The duration of daylight in summer depends upon latitude Opponents of the daylight saving scheme in England have pointed out that there would be no advantage in adopting such a plan in Scotland, where people already have more daylight in summer than they can use There is still less reason for advancing the clocks in Norway and Sweden and that these countries have as reported, adopted the new plan or are favorably considering it is hardly explicable except on the supposition that they wish to conform to Germany's newly inaugurated time

The expedient of changing the clock in order to change people's habits has its pros and cons. Wherever standard time is in use, people have already abandoned the idea that the time o' day" depends strictly upon the position of the sun in the sky The process of altering the clock and retaining the present nominal hours for various daily events is undoubtedly much simpler than to change these hours nominally as well as actually On the other hand, the alternate setting of the clock forward and back twice a year undoubtedly presents opportunities for much confusion. The conflict between scientific and popular requirements is probably not so serious as has been claimed in certain quarters. Astronomy and other sciences will continue to use the time best adapted to their needs.

A fundamental question, not yet satisfactorily answered, is whether a general change in the hours of people's daily activities is really desirable, or even practicable In all civilized countries there is a tendency to keep later instead of earlier hours, and the daylight-saving plan appears to be a somewhat violent effort to combat the instinct, whatever it is, that underlies this tendency. A very large part of the population, including farmers and artisans whose work is carried on out of doors, is already compelled to utilize the early daylight hours. The rest of the population has apparently adjusted itself to an alternation of natural and artificial illumination that is perhaps analogous, in its psychical if not its physical effects, to the alternation of summer and winter, or to the warm and cold spells of a cyclonically-controlled climate. It remains to be proved that this adjustment is not a wise and wholesome one, and whether we should be justified in upsetting it for the sake of curtailing the cost of lighting.

Aeronautical Notes

The World's Altitude Record was broken on April 26 when Harry G Hawker flew to a height of 24,408 feet in an aeroplane at Brooklands, England, according to an announcement made by the Royal Aero Club. Although Heinrich Hoelerich, a German aviator, attained a height of 25 756 feet in 1914, this feat has not been recognized by the Royal Aero Club.

New Battleplanes of the Italians.—A correspondent of the *Berlingske Tidende* who has visited the Austrian front reports that the Italian battleplanes are superior to those of the Austro-Hungarian forces, and that the latter have not been slow in realizing the fact. The large battleplanes of the engineer Caproni are specially marvelous and better than all other types. He goes on further to state that on the Isonzo front alone there are 80 of these huge machines and the Austrians have not as yet succeeded in bringing down a single one.

New Speed Records in France.—In the *Journal* M Georges Prade makes the following announcement: "On April 10 French aviation established new speed records. Needless to say no exact figures can be published so that we must perforce be content with stating that a new aeroplane, driven by a new engine, has beaten, on two occasions, all the previous world's speed records, not only for military machines but also those set up in time of peace by machines which at that time did not appear to possess any military value."

Successful Raids on Constantinople by British Aviators.—On the evening of April 14, three British seaplanes flew over the Aegean Sea across the Sea of Marmora to Constantinople and back a total distance of 300 miles, and dropped bombs on the Zeitunlik powder factory and on the aeroplane hangars. A fourth machine visited Adrianople and dropped bombs on the railway station. All four aeroplanes returned safely. Although the weather was fine at the start, adverse wind and a thunder shower were encountered later on. The powder factory blew up and the war office was hit a great deal of damage being done. This raid was remarkable in view of the fact that the British aeroplanes are not up-to-date machines and their motors are very often unreliable.

An Enemy Opinion of the German Fokker.—In reply to a newspaper correspondent's request for an opinion concerning the German Fokker monoplanes, of which so much has been heard of late, M Bleriot, the aviation pioneer, replied: "It is a very greatly overrated machine and no better than the aeroplane we have had in France for a long time. I refer to Morane-Saulnier. The German machines are, without doubt, inferior to ours or yours but they have an engine, the Mercedes, which is as good as, but no better, than the French engines. Never for a moment has Germany had the mastership of the air and now that we have this machine we have established a lead which will never be wrested from us." The new machine referred to is called the "spad," and has a speed in excess of 125 miles per hour.

Remarkable Raids by French Aeroplanes.—On April 17, 22 French aeroplanes flew over the head quarters of the Bulgarian staff of Doiran at 3 A M and inflicted considerable damage. German aeroplanes attempting to defend the position were driven off by special rapid fighting aeroplanes of the French which made tremendous speed. Other French air squadrons bombarded the camp of the enemy at Strumnitza and Bogantizi the day before. There has also been great activity at Verdun, a French squadron of machines having dropped bombs on the railway stations at Conflans Pagny, Arneville and Rombach. A French aviator, during the night of April 15-16, succeeded in dropping 16 bombs from a height of 300 feet on the deck of a German vessel on the North Sea. The war office reported that 11 of the bombs hit the ship, resulting in extensive damage.

The Dropping of Bombs on Washington and New York.—To arouse the populace, on the evening of April 16, aviator De Lloyd Thompson looped the loop over Washington and dropped numerous fireworks bombs. His aeroplane was illuminated with magnesium flares to make this exhibition. The bombs were dropped so that they exploded above the capitol and other public buildings. Aviator Thompson showed how easy it would be for aviators from an enemy fleet to swoop down upon the capitol and destroy it. He repeated his performance above lower New York and Brooklyn on the evening of April 19, making a triple loop and performing astonishing gyrations. He dropped bombs over the Custom House and Whitehall Building. One of these failed to release and exploded while attached to the aeroplane damaging the fuselage and almost upsetting the machine. Aviator Thompson managed to resume control, however, and alighted safely on Governor's Island at 8:31 P.M. after having flown for 14 minutes.

Astronomy

Observations of Nocturnal Radiation were made in Swedish Lapland during the continuous darkness of last January by Dr A. K Angström, well known for his studies on solar and terrestrial radiation in this country and Europe.

Markings of a New Kind on Mars were observed at the Lowell Observatory at the recent opposition according to note by Director Lowell. The new features appear to be secondary to the main canal net work. A tiny dot is seen within some of the polygons made by the intersections of certain canals, and from this extremely delicate lines extend to a corner and to the sides of the polygon. The effect is described as that of a centrally woven web spun within the borders of the polygon, of a more minute order of tenuity than the polygon itself.

The Value of Meteor Observations is possibly even greater from a meteorological than from an astronomical point of view. This aspect of such observations is emphasized in the last report of the meteor committee of the American Astronomical Society, the chairman of which, Prof Abbe, is the dean of American meteorologists. Meteors furnish information regarding the composition and movements of the atmosphere at levels far above those attainable by ballooons. In this connection it is only necessary to recall the studies of Prof C C Trowbridge of Columbia University on the drift of meteor trains, similar studies by the little band of British meteor observers headed by the veteran Denning, and recent investigations by Dr A Wegener in Germany on the composition of the air at different altitudes as indicated by the solors of meteors.

The Discoverer of the Great Nebula in Orion.—The discovery of this object was formerly attributed to Huyghens, who describes it in his "Systema Saturnium," published in 1659. In 1854 R Wolf called attention to an earlier description by J B Cysatus of Lucerne, published in 1619. Cysatus saw the nebula as early as 1618 and possibly as early as 1611. The history of this greatest of all nebulæ is now carried still farther back by G Bigourdan, who quotes in the *Comptes Rendus* from the manuscript journal of Peiresc observations of this nebula in November and December, 1610. Thus it appears that Peiresc made the first telescopic observation of a nebula of which we have any record. The earliest telescopic observation of the Andromeda nebula was made by S Marius in 1912. Bigourdan is inclined to doubt the earlier observations of the Andromeda nebula with the naked eye, mentioned in most books on astronomy.

Arequipa Pyrheliometry.—Dr C G Abbot of the Smithsonian Astrophysical Observatory has recently published a discussion of the pyrheliometric observations made from 1912 to 1915 at the high level station of Harvard College Observatory at Arequipa, Peru. He states that "the Arequipa results confirm the variability of the sun both from year to year and from day to day shown by investigations at Mount Wilson and elsewhere." He suggests that if similar observations could be maintained at eight or ten favorable stations at high altitudes in various parts of the world the variations of the sun could be determined almost or quite as certainly therefrom as from two stations equipped for complete spectromolometric measurements of the solar constant. One interesting result of the Arequipa observations is that no effect upon atmospheric transparency was produced there by the dust from the eruption of Mount Katmai in 1912, though such effects were general in the northern hemisphere for more than a year after the eruption.

Astronomical "Bulls" are a sovereign antidote to the tedium of plodding *per aspera ad astra*, and their number appears to be unlimited; hence the astronomer has no excuse for being melancholy. Many delectable specimens have been recorded in our columns and we are always glad to add to the list. From the current number of *Popular Astronomy* we learn that a certain newspaper, in describing the February solar eclipse, announced the time at which observers might see the "shadow" coming across the face of the sun. Since the sun is the source from which planetary bodies are illuminated one wonders by what process the news paper writer supposed that a shadow could be thrown upon this luminary. From a recent number of *Sirius* we learn that when the German astrophysicist J F Krüger died recently in Denmark, he was quite generally described in the newspapers of his own country as an "astrophysiologist." *Sirius* points out, however, that the term "astrophysiologist" although inapplicable in Krüger's case, is not so incongruous an expression as it appears to be at first sight. It applies very well to such persons as Prof Adolph Marcuse, of Berlin, who has made a special study of errors in astronomical observations due to physiological defects in the observer.

Radio Communication

A New Wireless Record is believed to have been established on April 26th when the operator in the San Francisco beach station picked up a message stating the position of the steamer "Sierra" 4,870 miles out from that port on her journey to Sydney, Australia.

Australian Radio Service.—The Australian Minister for the Navy states that the Cabinet has decided that the whole of the wireless telegraph stations should be under the control of the Navy Department and the new service will be called the Royal Australian Navy Radio Service. Those employed on shore will wear uniforms similar to the naval uniforms with a slight difference in badges.

Weather Observations Reported by Radio.—At the request of the Weather Bureau arrangements have been made by the United States Bureau of Lighthouses for taking weather observations on the light vessels at Nantucket Shoals, Mass, Diamond Shoals, N C, Frying Pan Shoals, N C, and Heald Bank, Tex. These light vessels are all equipped with wireless apparatus by means of which observations may be transmitted to any point desired.

A New Wireless Station for Norway is announced in a recent issue of *Engineering*. The station is to be erected at Ooresiter and the contract for the work has been let to the Gesellschaft für Drahtlose Telegraphie of Berlin. The station which will have masts 300 feet high is intended for communication with the large European wireless stations. It is also proposed to erect a small station for shipping. It is expected that the new station which will be equipped on the same principle as that at Nauen near Berlin will be ready in the autumn and the cost will be about $110 000.

Work at the Mare Island Station.—The construction of the 400 foot towers for the new long-distance station at Mare Island, near San Francisco, is well under way. It is believed that when the 30 kw apparatus is installed the Mare Island station will be in constant touch with ships of the navy along the Pacific Coast as far as the southern boundary of Mexico. The station will also be able to communicate with land stations along the coast and with the Government station at Arlington, near Washington.

Wireless Communication Between Kentucky Mines. It is reported that two Kentucky coal mining companies are preparing plans for wireless telegraph service between several coal mines in Harlan County, Kentucky, and the main offices in Louisville. It is said that the sending station is to be located in the Black Mountains where the Cumberland range reaches its highest elevation in the state. The receiving station will be on the Starks Building, Louisville. The distance on an air line is in the neighborhood of 200 miles although by rail it is nearer to 300.

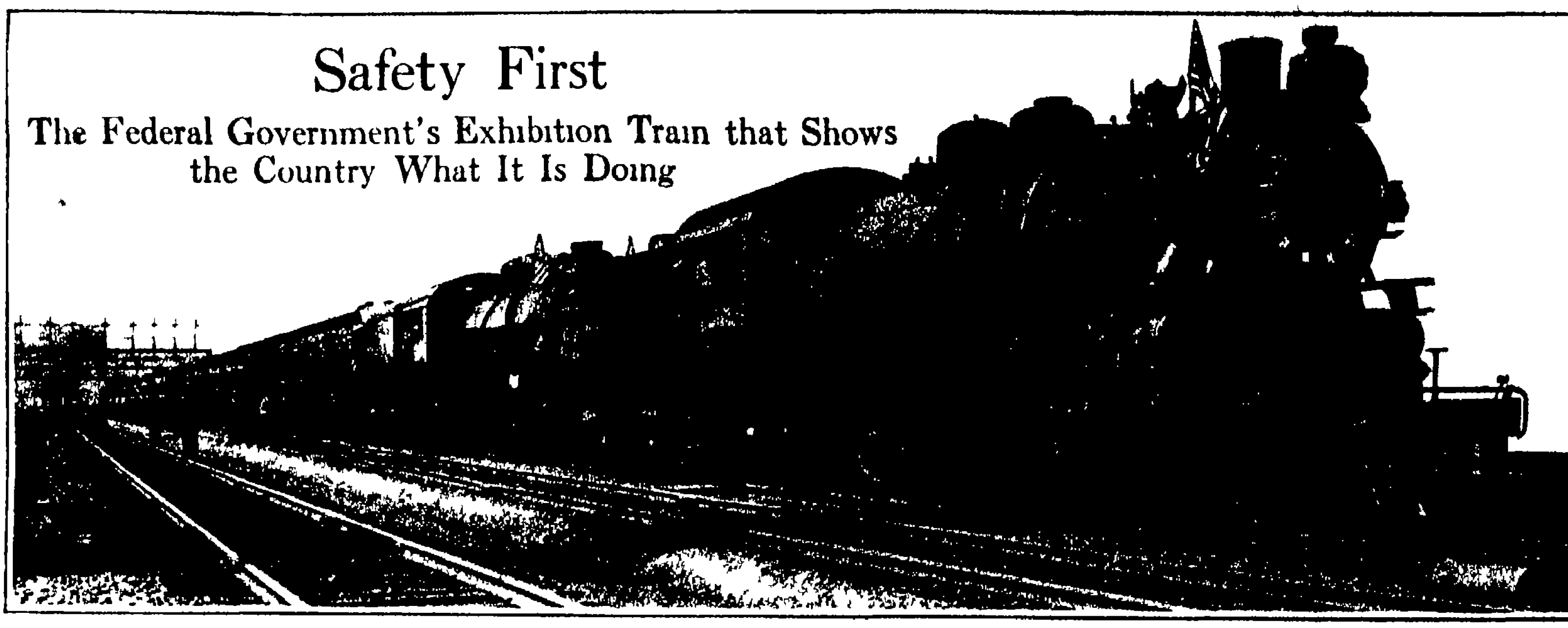
New Theory for Electrolytic Detector Operation.—In a paper presented by Prof Wilder D Bancroft before the recent Washington meeting of the American Electrochemical Society an interesting theory is presented and offered for the *modus operandi* of electrolytic detectors, crystal rectifiers and coherers, namely, that electric voltage squeezes out, or at least in some way decreases the thickness of the absorbed gas film and thereby decreases the resistance of the detector. The paper is certainly welcome as a stirrer of opinions, comments the *Electrical World*, and as a gauntlet thrown to the advocates of thermoelectric action.

Radio Phenomenon Encountered in Mexican Campaign.—According to the *Wireless Age* the wireless service men with the American punitive expedition into Mexico were surprised to discover that conditions in that country were exactly the reverse of those in the United States. In our own country the wireless operators find that the night time is much better for the transmission of dispatches. South of the border the day time is best. There is so much atmospheric disturbance at night in Mexico that wireless men prefer the day as a time for operating. This is not due to the altitude, which is 7 000 feet, but to the minerals in the mountains, especially iron ore.

A Concealed Wireless Telegraph Station which exists in some part of Brussels has caused much annoyance to the local German authorities because of the fact that it has furnished the people of Belgium with war news which the Germans desired to keep from them. According to reports, the search for the station has thus far been unsuccessful, although as an added incentive a reward of $2,500 is being offered for information that will disclose the location of the troublesome plant. Since the wireless station appears to be used for receiving messages only, its detection is extremely difficult and resolves itself into practically a house-to-house search, but if the station were also used to transmit messages, its apprehension would be a simple matter.

Safety First

The Federal Government's Exhibition Train that Shows the Country What It Is Doing



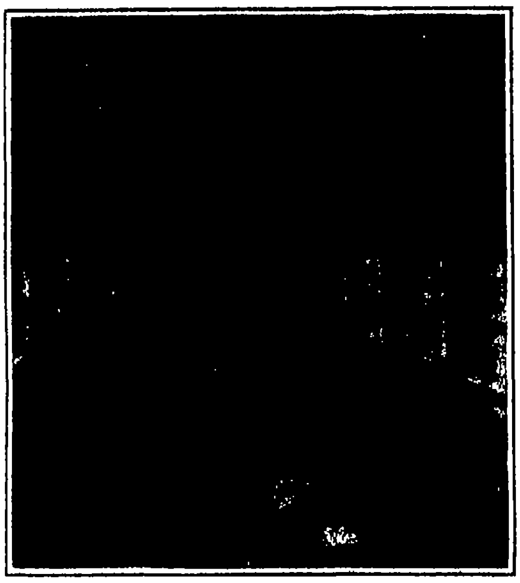
The Federal Government's safety first train leaving Washington on its tour of the Central States

A FAR REACHING result of the recent Safety First Exposition held in Washington by the Federal Government to show what it is doing toward the saving of life and property is to be found in the efforts now under way to bring this material to the attention of the country at large The Baltimore and Ohio Railroad Company has coöperated with the Department of the Interior in this to the extent of furnishing without charge, a 12 car, all steel train to accommodate the more significant features of the exhibit This train is being hauled over the entire B & O system stopping a sufficient length of time in each city or town to enable the residents to inspect thoroughly the various exhibits

After an inspection of the train by President Wilson the start was made from Washington, on May 1st, in the presence of Secretaries Redfield Lansing Daniels Lane and Baker The itinerary for the first month included one-day stops at Chester, Pa Wilmington Del , Frederick, Hagerstown and Cumberland Md , Winchester, Va , Martinsburg Grafton Morgantown, Fairmont, Clarksburg and Parkersburg W Va Marietta Athens and Chillicothe Ohio Vincennes Washington and Seymour Ind and East St Louis, Ill with stops of two days each in Philadelphia Baltimore St. Louis Louisville and Cincinnati After completing the tour of the B & O arrangements are to be made to take the train over the other trunk lines of the country, so that every citizen who cares to do so may see just what his Government is doing for him

The exhibit of the Public Health Service of the Treasury Department touches the people about as closely as any By charts and models this branch of the service illustrates its methods of dealing with epidemics and substantiates its claim that the freedom of the United States from typhus, cholera and yellow fever is mainly due to the efficiency of its quarantine Methods of protection of food, water and working conditions are demonstrated which go far toward accounting for the low death rates of our large cities

More direct activities in the saving of human life although not of nearly so wide application, are those exhibited by the Coast Guard. Life boats, life line guns breeches buoys wireless outfits are some of the implements employed by these courageous men and to be seen in the exhibit of their activities Likewise the Bureau of Mines has on display a complete set of apparatus for saving and conserving the lives of the miners The American Red Cross Society shows how it goes into the factory districts and teaches the workmen the principles of first aid to the injured Even the Weather Bureau makes it clear what part its storm warnings play in saving lives by keeping vessels out of dangerous regions or in giving dwellers in the river bottoms warning of approaching floods.



Car devoted to the Red Cross and the Coast Guard

Perhaps of less human interest, but of no less necessity, is the work of the bureaus which conserve not lives, but property and resources The Forest Service shows its methods of prevention and extinction of forest fires. The Reclamation Service illustrates its activities in bringing fertility to the waste places and making them habitable by man Among the exhibits of this bureau are many colored transparencies and moving pictures bearing upon the reclamation of 40 000 000 acres of land in the great American desert

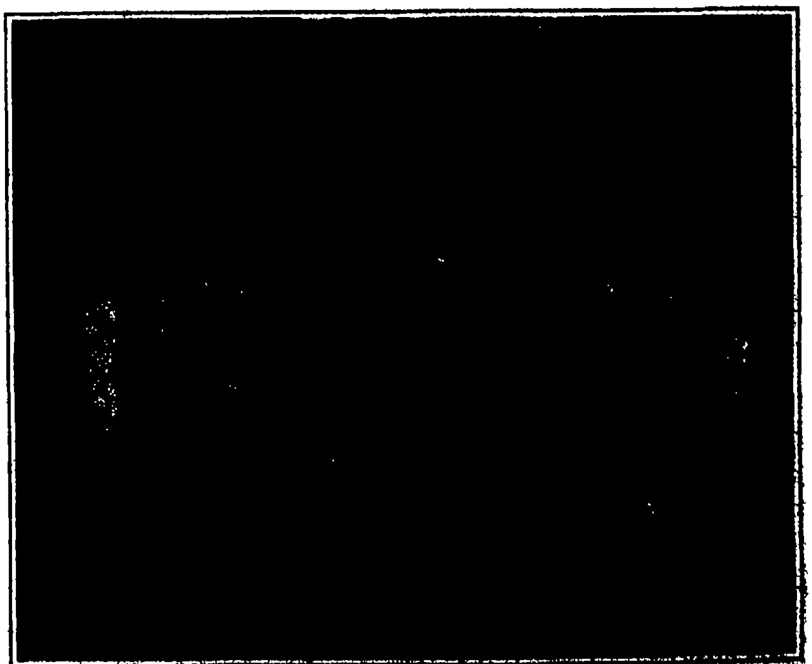
As a part of a truly American safety first program, the Departments of War and Navy have tried to show by means of a collection of models just how we are prepared to deal with a foreign foe. The turrets of the great battleships are here in miniature, there are machine-guns and representative types of warships, torpedoes and signal stations, all well worked out. Few people will be able to come away from this train without finding something to interest them and to enlarge their ideas of the scope of the activities of the Federal Government

Japanese Patent Rulings

COMPLAINTS have recently been made that the Japanese, in patent and trade-mark matters, are not construing their laws and rules of procedure in favor of foreigners in the same liberal manner that is done where the rights of Japanese are concerned. As these complaints have come from people thoroughly familiar with the actions of the Japanese Patent Office and other Japanese tribunals, it appears to be necessary that they receive attention

It would seem that the complaints have been occasioned by a misguided desire on the part of some petty officials to further the interests of Japanese at the expense of foreigners doing business in Japan and it is, therefore, believed that as was the case a few years ago, the trouble will be cured when those in authority realize the due significance of the rulings that have occasioned the complaints.

Interior of car containing the exhibit of the Bureau of Mines



Navy Department car, with preparedness exhibit

Helmets Worn as a Protection Against Dangerous Dusts

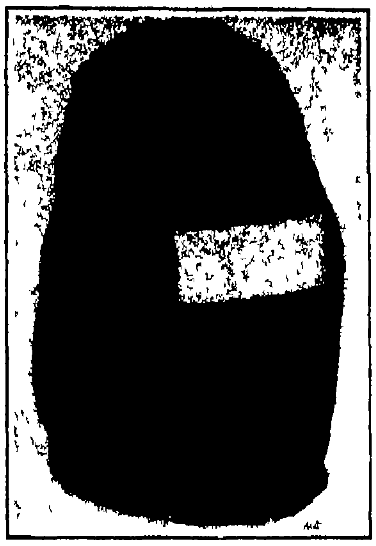
DUST of all kinds is a menace to a worker's health, especially if it is laden with metallic or sharp particles. So it is that among the dangerous occupations of the present day, sand-blasting is well in the foreground, although devoid of the spectacular. The manager of a well known Eastern foundry recently stated that "a sand blaster lasts about five years, rarely any longer." After that time the millions of sharp particles of sand have practically sand blasted his lungs.

If the sand blaster is to be protected against the bombardment of the myriads of sand particles, it is essential that he be provided with some suitable form of respirator or helmet. The former has been in use for years past, but the latter is only now coming into greater use. An American firm recently completed a series of tests in order to determine first, the force of the impact and the abrasive energy created by sand blasting, second, the fineness of the sand after it has struck the casting, third, the properties of the sand after it rebounds. As a result of the knowledge gained, there has been designed a helmet which is said to meet all the conditions encountered in the work, and which affords protection for the eyes, ears and lungs.

Four shields of multiple metal screens admit air and light, but form an impenetrable barrier between danger and the man wearing the sand blaster's helmet. A frame holds the hood away from the head to form a 2 inch air space all around, permitting of the free circulation of air, thus hot, stagnant air cannot collect inside the hood. The multiple screens are of sufficient toughness to resist the blow of the sand, while the frame, although light in weight, is very strong. The hood will withstand the hardest kind of wear.

In conjunction with the sand blaster's helmet, a hood of light material may be fitted over the same frame. This hood drops to the neck of the wearer, where it can be tightened by means of a draw string. A window, which may be either transparent celluloid mica or glass, permits vision. Free circulation of air within the hood is facilitated by six ventilating screens in the top and four in the skirt. In babbitting operations the same head frame is again used, this time to support the wire mask on the head. The mask is made of three parts. Two parts of semi spherical shape form the cap. A ridge or comb where they join adds rigidity. The apron, dropping to a point considerably below the chin of the wearer, extends in width around one third the circumference of the head frame, therefore reaching almost from ear to ear, and giving ample protection from the splashing metal. An added protection for the eyes are the two squares of heat treated glass.

The multiple screens used in the helmets and hoods consist of a number of metallic screens of very fine mesh arranged in suitable combination. These devices take the place of respirators and goggles in the instance of the dust hood, and permit men to work in places filled with lampblack dust, carbon flour, lead dust, oxide of iron, and other dangerous dusts, without injury to health. The advantages of the helmet and hood over respirator and goggles is that they are more comfortable to wear since nothing touches the wearer's face, and that aside from protecting the wearer's lungs, his ears and hair are likewise safeguarded.



Hood used as a protection against dangerous dusts

Mask worn by workers engaged in babbitting operations

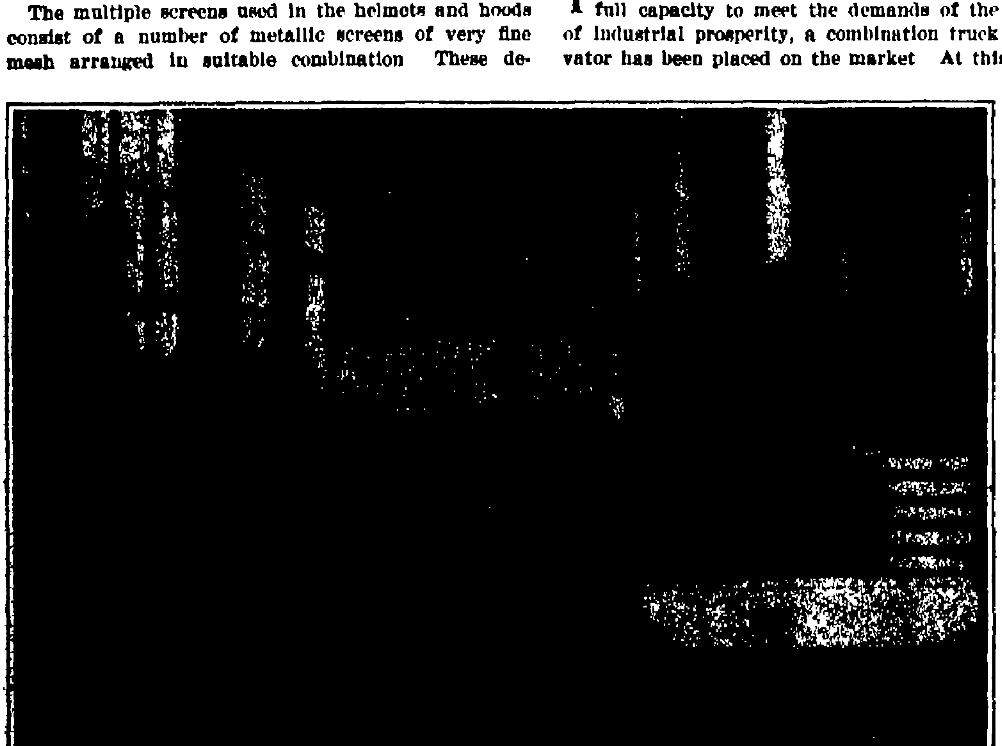
Bonding or joining electric railroad rails together by means of an electric arc

An Electric Truck Which Carries Its Own Elevator

TO speed up trucking methods in plants working at full capacity to meet the demands of the new era of industrial prosperity, a combination truck and elevator has been placed on the market. At this writing it is being installed in fleets of 50 or more in some of the larger plants. One man can operate it and accomplish the same work that ordinarily requires the services of from five to ten men.

The truck is gear driven and is equipped with a platform which may be raised or lowered by a special electric lifting device driven by an individual motor taking power from the truck battery. The platform will elevate a load of 4000 pounds 3 inches in 7 seconds, and the truck loaded to capacity can convey the load to its destination at a speed of 5 miles an hour and there deposit the loaded platform.

In plants where it is now installed goods are placed on platforms in various parts of the building and are moved at a minimum expense of time and labor by the truck. If desired the truck can be used for ordinary trucking purposes or it can be used as a tractor to haul ordinary trailers from place to place. It is constructed of I-beams, steel castings, and drop forgings and the controller is of the vertical type with three speeds forward and three in the opposite direction. The control of the lifting device is automatic, and when it is desired to drop the load this can be done in from three to five seconds.



Combination electric truck and elevator about to run its platform under a load of rubber-tired wheels

Electric truck after lifting up the load clear of the floor, ready for its trip

Making Railway Rails Continuous by Means of the Electric Arc

A CONTINUOUS conductor is obviously more efficient as a path for an electric current than one made up of a number of sections more or less securely joined together. This, then is the reason why electric railroads spend large sums of money in joining or "bonding" their rails together, for the connecting plates used in joining mechanically the ends of two rails form but a poor electrical connection, and when it is borne in mind that these joints occur every 30 or 40 feet, it becomes apparent that the aggregate resistance in a mile or more of track is tremendous.

Heretofore the bonding of rails has taken the form of small copper cables or strips connecting together two adjacent rails. But since the ideal both from a mechanical and electrical viewpoint, is a continuous rail in recent years the railroads have been resorting to various methods of welding, to a greater or lesser degree, the rails together, using the casting process, thermit, or electricity. The latter has been accomplished by two distinct methods: first, the resistance method, in which a heavy current is caused to pass through a poor joint between the rails, the resistance of which heats the steel to a point where the metal actually runs; second, the electric arc method, in which the joint is heated to incandescence by an arc drawn between the rails and a carbon or metal electrode. The latter method is perhaps the most common in present-day practice.

A typical arc welding outfit for rail bonding aver

(Concluded on page 626)

Strategic Moves of the War, June 2nd, 1916

By Our Military Expert

ONE of the most consistently noticeable things of the European war is the way in which the general staff of the Central Empires never overlook anything in either the situation or in the art of war For years it has been conceded in a general way that the German army was the best in the world in point of organization as well as discipline—a veritable cold blooded fighting machine But the war has made this generalization most specific

This is apropos of the Entente force collected in an out-of the way spot on the map Saloniki into which vicinity its nucleus was driven during the clearing of Serbia when a belated attempt to aid this small ally was made

After many months of talk regarding the imminence of the launching of a general offensive by the Entente Powers every indication reasoning as well began not many weeks ago to point to its inauguration with the coming of propitious weather in the current spring As the initiative in war means much to the side retaining it *Germany at the most auspicious moment and realizing* the preponderant numbers against her at this phase of the war promptly blocked the Allies little game by the opening at Verdun of the most stupendous battle-siege the world has ever witnessed Germany took hold at this point and, with eminent military sagacity and tenacity has not let go even though there now appears small likelihood of a tactically successful decision accruing to her but as long as Germany can continue her assaults at Verdun the initiative remains with her

General Cadorna the Italian generalissimo paid an important visit to Paris to consult with the members of the Allied council and reports were freely circulated that the Italian army was about to arouse itself and press forward The next thing the dispatches recounted was the heavy Austrian attack in the Trentino driven home by the hammering of a superior artillery The Italians—and their Allies—were again forestalled and the former are extremely busy meeting the threat to the Venetian section of their land

After the withdrawal of the Allied forces from Serbia diplomatic necessity became the deciding factor in halting Teutonic pursuit at the Grecian border There existed—and exists to-day—a powerful war party in this ancient nation of Athens which held that the destinies of Greece must coincide with those of the Entente The court party of decidedly pro Teutonic leaning, resisted the popular demands and on the plea of preserving strict neutrality through holding the reins of government has been able to keep the Greek forces from under the standards of the Entente The national situation was complicated by the affiliation of the Bulgars—frankly inimical to Greece over the question of Macedonia—with the Central Empires. Diplomacy intervened for fear of boiling the kettle over and as a result Greece presented the odd spectacle of maintaining technical neutrality toward the Kaiser while she of necessity paid part of her treaty obligations to his enemy by permitting the use of a section of her territory by the Entente

The comparatively slender Entente forces which occupied Saloniki after the retirement from Serbia have been vastly increased since that time In addition to the French and British troops which compose the bulk of the force more than 100 000 Serbians armed and re-equipped by the Allies are now present within the lines It is impossible to say with any degree of accuracy what the total force may be but compilaton of various reports received in this country since the occupation of Saloniki lead to the belief that from 500 000 to 600 000 men is not far wrong

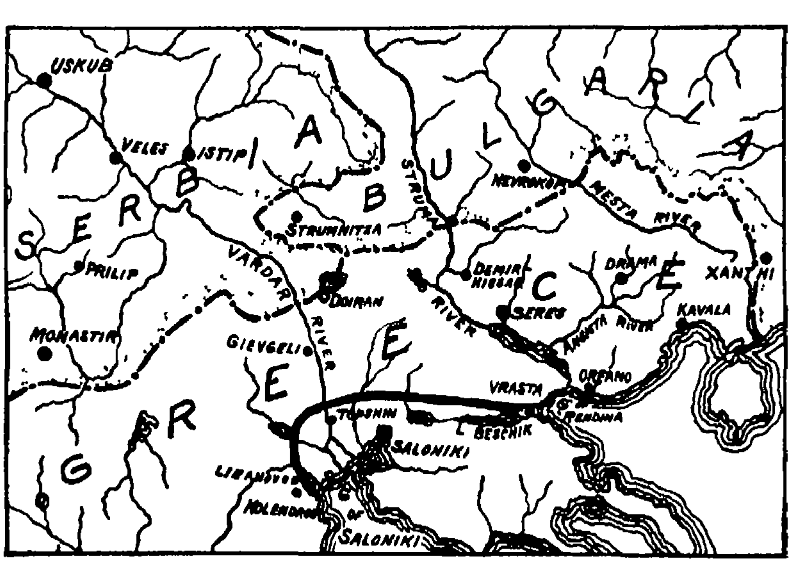
Call it the lesser number Even in this war of grand arithmetic a distinct and concrete army of half a million men is a very powerful force—in this case powerful enough to initiate an offensive thrust northward against the railway from Germany and Austria to Turkey and Constantinople It establishes a very real threat a thorn in the side of Teutonia for it is fairly on the strategic flank of its communications and rather near at that

This force has certainly not been gathered at Saloniki merely to occupy Grecian territory no such preparations as have been made for its adequate maintenance would have been completed for such a purpose and the deduction is very easily made that the greatest object of the force is to undertake such a northward thrust when the time and circumstances are promising to success.

Again reports have indicated for some time that activity was about due from Saloniki But the German staff realizing that diplomacy has won its all by holding Greece inactive as long as it has and that there would be nothing to gain once the Entente should begin an advance has removed the leash from the Bulgarian war dog and to seize better and more advanced defensive positions against the day of battle has permitted Bulgaria to cross into Macedonia seize Greek defenses and obtain a foothold upon her desired land, ignoring the factor of possible Greek participation against her as a result—or else Berlin must have a very thorough understanding with Athens.

Teutonic and Bulgarian troops advanced a short distance along the River Mesta at Xanthi and toward Demir Hissar while it is reported that strong concentrations of troops have been made near Doiran and Nevrokop

The lines of Saloniki are of two general classes, the advanced positions and the line of defense The latter is a very obvious one and makes for economy of manning It begins on the east near Vrasta on the Gulf of Rendina, or Contessa, or Orfano—take your choice—and follows the line of the river which is the outlet of Lake Bashik The lines now lie north of the lake, but should necessity compel a retirement this lake and its smaller neighbor more to the westward form excellent and firm points of rest to the general line In the vicinity of the railway to Gievgeli which is crossed by the main line of defense there are a number of eminences which form excellent positions of defense The line crosses the Vardar at Topshin, proceeds approximately ten miles farther west then turns abruptly southward to end securely on the Gulf of Saloniki in the vicinity of Libanovo and Kolendros.



The region about Saloniki, showing the line of defense

From this entire line northeast, north northwest and west the advanced positions occupy the ground to a considerable distance To the northward are broken ranges of hills and mountains whose passes and crests must be forced ere General Sarrail's force can materially advance toward the Teutonic communicatons with Turkey, and it is to prevent the occupancy of these hills by the Allied forces that the Bulgarians have moved forward.

Soon after Saloniki was occupied in force by the Entente comparison was drawn in this column between the present situation and the lines of Torres Vedras in the Peninsula campaign when Wellington, beaten back by the armies of Napoleon, established himself about 70 or 40 miles north of Lisbon with his right on the Tagus while his left lay securely upon the Atlantic, and all the assaults directed against him failed to shake his hold When the time was ripe he turned upon Massena and drove him to the defeat which eventually resulted in the downfall of Napoleon

To return to the theme, for the third time the Teutonic staff has forestalled—or possibly anticipated—an offensive movement on the part of its enemy And while the great struggle has continued for weeks on the western front this same staff has found it expeditious to take offensive action

It may reasonably be expected that Russia's turn will come, but the problem should be harder on account of the vast extent of the Russian line from Riga to Roumania It may come toward Riga, Dvinsk, Minsk or Rovno, the most important railway junctions of the entire line And if it comes, it will probably be found that it almost exactly anticipates the assumption of the offensive by Russia But Germany has less to fear there than elsewhere, for reports of conditions indicate that while Russia is actually far better off in a military way than at any time since the war began, she is nevertheless not yet prepared to undertake her general forward movement in full strength to promise success. Her easy sweep in the beginning of the war was possible because her mobilization was consummated earlier than the German staff expected, when Germany's hands were occupied with the throat of France.

The Balkan theater of war is well worth watching No one can tell where the first major diversion on the part of the Entente will occur and it may easily be a joint one participated in by Sarrail's force thrusting to the north while Russia strikes southward.

The Physics of a Smoke Ring

By Leigh F. J Zerbee, 2nd Lieut., C A C, U S A.

IN the firing of large caliber mortars the spectacular smoke ring is of rather common occurrence To the layman it is simply a beautiful and interesting sight to be watched until it disappears in the clouds. However, when an artilleryman sees one issue from the muzzle of his piece he expects that particular projectile to fall short, and unless other conditions make a compensating error his judgment will be correct From the foregoing it is to be understood that this phenomenon is undesirable The following is offered as an explanation of the cause of the smoke ring

Every one is familiar with the appearance of the modern projectile, a long cylindrical body with a flat base at one end and a point at the other Just forward of the base and encircling the projectile is the rotating band It is made of annealed copper The powder chamber of a mortar is of larger diameter than the rifled portion of the bore consequently the chamber and bore must be connected by a cone. The after part of this cone is unrifled and is called the centering slope The forward portion is rifled and is known as the forcing cone The rotating band is turned to the same surface as the cone in the gun and when the projectile comes to rest in the bore, after having been rammed, a gas tight joint is effected between the gun and the projectile Thus the rotating band here is in reality a valve and the centering slope its seat Projectiles are rammed with all the force available so as to seat them securely and make an absolutely gas tight joint After the ramming of the projectile the powder is loaded and the breech closed At the time of the explosion a great pressure of gas is formed behind the projectile which causes it to move forward flowing the copper band down into the grooves of the rifling and preventing any escape of gas If gas does escape, due to improper seating, dented or otherwise mutilated rotating band, or other reason the pressure acting on the projectile is lowered and the shot will fall short.

This leaking of gas past the rotating band is the cause of the smoke ring It takes position in front of the projectile in the form of a smoke piston and is pushed from the bore by the projectile Even though this piston of gas while in the gun is forward of the projectile, still, due to the rapid motion of the projectile, it is under greater than atmospheric pressure. When it issues from the muzzle it immediately expands, according to Boyles Law, and the next instant is pierced by the charge This changes the smoke piston to the smoke ring The queer "turning inside out motion" they have is caused by the charge going through the ring and its friction against the inside of the ring setting up a rotation. A similar motion may be obtained by placing a small rubber band around a broomstick and pushing it along the stick by the hand which at the same time loosely grasps the stick

The fact that the ring continues to increase in diameter as it rises is probably due to the kinetic energy given to it in that direction by the force of the expanding gases at the muzzle. It rises from the piece at first swiftly and then more slowly The rapid rising at first is explained by its velocity from the mortar; this soon dies off, however, and its ascent continues by reason of the fact that it possesses a lower specific gravity than air

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Open Sights vs. Peep Sights

To the Editor of the SCIENTIFIC AMERICAN:

Articles on the above have appeared in your issues of Dec 11, 1915, January 22, 1916 and April 15, 1916. These articles are by Mr. Crossman and Mr. Winans. Mr. Crossman states that the peep is quicker than the open. He also states that the open sight is used when in a great hurry. These contentions appear to contradict. He states that the peep is ignored. He also states that the peep must be found, that the head must be placed in the right position so as to look through the peep, that the peep must be looked through at the outset. These contentions look very much like further contradictions. It certainly does not seem possible to ignore the peep, and at the same time search for it.

Mr. Winans states that the peep is useless in poor light, which lasts about half the time. Mr. Crossman does not deny this statement, hence must be taken to have admitted it. The same thing applies to Mr. Winans' statement that the peep is useless for moving targets.

Neither Mr. Crossman nor Mr. Winans states how useless the peep would be in the mud and slush of France and Belgium.

The reason why the open sight is used when in a hurry is that the target, the front sight and the surroundings are never lost sight of, as Mr. Winans states. On the contrary, when the peep is used the front sight, the target, and the surroundings are lost to view from the time that the plate which contains the peep comes before the eye until the peep is found, the head got in the right position, and the peep is looked through. After these things have been accomplished, the front sight must be searched for and found, the surrounding country must be searched over and the target found. When all these tasks have been performed the gun must still be sighted.

When in a hurry, when the light is poor, and when the object is moving the peep is manifestly unfitted for use. Unquestionably, the peep when it can be used, is more accurate than the open sight. The telescope is more accurate than either, but that fact would not justify the general use of the telescope.

The accuracy of the peep induced both Americans and Canadians who were after mere amusement at the target to adopt the peep. The hope of securing trophies by somewhat questionable methods, that is, by the use of sights unsuited for war purposes generally induced both Americans and Canadians to adopt the peep in foreign competitions.

Mr. Crossman speaks of accuracy. He also advocates the use of a battle sight, which does away absolutely with anything resembling accuracy. His two positions on accuracy seem at least queer. What would be thought of a man who started out to hunt game with only a battle sight on his gun? The man who would do it would certainly be considered a little peculiar. Precisely the same thing applies to hunting men.

The meaningless term "flat trajectory" appears to have led some men astray. There never was and never will be a flat trajectory.

As to accuracy of guns, which is another meaningless term or phrase, no gun is accurate. No gun can be sighted. Sighting is mere approximation. I do not refer to battle sights, which are never intended to be sights at all. Curiously, neither those who make guns nor those who use them seem to desire that guns should be more nearly accurate than they now are, though they could very easily be made more nearly accurate.

C. C. GRANT, M.D.

Box 422, Red Deer, Alberta.

Possibilities of the Transatlantic Flight

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of May 6th is presented, in a letter in the Correspondence Column by George Tanzius, an elementary proof that the "average machine" cannot fly across the Atlantic in a non-stop voyage. "These figures," it is stated, "prove conclusively that the non-stop flight across the Atlantic is beyond the present possibilities."

The writer concludes by censuring Mr. Curtiss for lending his name to such a project. "It is inconceivable to me," says he, "that any persons having even a slight knowledge of aerodynamics would lend their names and endorse such an undertaking."

Permit me, by use of the writer's method of argument and somewhat better data, to prove the possibility of a non-stop flight across the Atlantic. Mr. Curtiss says he can build a 3,600-pound flying boat of 600 horse-power, using .55 pounds of fuel per horse-power. The weight per horse-power is, therefore, as follows:

Fuel for 30 hours	16.5 pounds per horse-power	
The machine	6.0	"
Two pilots	0.5	"
Total	23.0	"

This 23 pounds load requires 23/6 = 3.83 pounds thrust per horse-power, whereas a propeller of 100 per cent efficiency can exert a thrust of 5.36 pounds at 70 miles per hour, the assumed speed. The ratio 3.83 ÷ 5.36 = 71 per cent, is therefore the necessary propeller efficiency in Mr. Curtiss's proposed craft. But he can build propellers having greater efficiency than is here found necessary. Furthermore it is not necessary to fly at 70 miles an hour for 30 hours, since the proposed route to Ireland is only 1,800 miles long.

Having proved from the data supplied by Mr. Curtiss that the non-stop flight is possible, I may remark that he is not pledged to such a flight with the machine above referred to, but has made provision for stopping en route for supplies from a ship.

It thus appears that Mr. Curtiss is not, for want of "a slight knowledge of aerodynamics," venturing upon an ill considered or a preposterous enterprise. On the contrary, he has an aerodynamical laboratory of his own, a technical staff of trained and experienced aeronautical engineers, and has had himself the largest practical experience of any man in America in the construction of varied types of aircraft.

A. F. ZAHM.

Buffalo, N. Y.

The War Game Series

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to thank you for your attention in the matter of the war game. This project, undertaken by a publication of the standing and circulation of the SCIENTIFIC AMERICAN while in a way a novel departure for any other than a service magazine, is worthy of great commendation as educating your readers in a matter of such great present importance. Any student of the war game will receive a very excellent idea of the methods and procedure of modern military practice and he is bound to derive considerable instruction along the lines covered. The military students, for example, officers and men of the National Guard or members of the Business Men's Training Regiment who are pursuing military studies should find the course covered by your war games of very material assistance in their work. In my opinion the SCIENTIFIC AMERICAN, in thus presenting such a game, performs a great public service.

JOHN F. O'RYAN,
Major General.

Headquarters Division National Guard, New York, Municipal Building, New York.

The Battle of the North Sea

NOT until the detailed reports of Jellicoe and Beatty are made public will it be possible to write the technical story of the great Battle of the North Sea or the Battle of the Skagerrack as it may possibly be called. The earlier German official accounts following the policy of concealment of losses as practised by the army have proved to be unreliable, although later dispatches admit the loss of additional ships to those given in the first radiograms to Sayville.

The outstanding fact, at least for the casual student, is the closeness with which the theories of naval construction and naval tactics were verified. The various types of vessels engaged on both sides were maneuvered, fought, suffered or won, exactly as the text book had foreshadowed.

Briefly stated the Battle of the North Sea was a first class engagement resulting from a hostile demonstration against the German High Seas fleet on the German side of the North Sea in which after serious and (as it now begins to apear) approximately equal losses on each side, the German fleet was driven back into its home ports, leaving the command of the sea to Great Britain.

It is evident that both the British and German main fleets were out in force. The descent of the British on the German coast were carried out in conformity with the conventional disposition of a fleet that is seeking the enemy. In the van were the fast scouts and destroyers. Back of these were the battle-cruisers and armored cruisers (though what these relatively slow, lightly armored and lightly gunned ships were doing in company with the battle-cruisers is puzzling), and far to the rear (too far as the event proved) was the main force of British dreadnoughts.

The disposition of the German fleet was similar with the important exception that their main battleship fleet was in close touch and well up with its screen of scouts and battle-cruisers—as the British battle-cruiser fleet was to discover before the engagement had been long in progress.

The scouts and destroyers of the two fleets were the first to make contact, and at once they fell to with the characteristic dash of these vessels. Next the battle-cruisers became engaged, and Admiral Beatty pushed forward at full speed in the effort to place himself between the German battle-cruisers and their base—the Kiel Canal or the Bight of Heligoland, as the case might be. The maneuver promised to be successful, but while he was hotly engaged with the German battle-cruiser division, which was apparently to starboard, there loomed up to port the main battle line of the German dreadnought battleships.

Probably the situation was of the German admiral's making, for it is known that he was assisted by one, and according to neutral testimony several Zeppelin scouts. It is fairly certain that due to superior information the Germans had a far more accurate knowledge of the strength and position of the British than the British had of the German forces.

It was during this phase of the engagement that the British losses occurred. The battle-cruisers and armored cruisers with their relatively light armor, were overwhelmed by the broadsides of the combined battle-cruisers and battleships of the German fleet. Three British battle-cruisers, the modern "Queen Mary" mounting 13.5-inch guns and the older "Indefatigable" and "Invincible" were blown up by internal explosions and sunk. Whether the blowing up was due to gun fire or the torpedo has not, at the present writing been reported. The 9.2-inch guns and 6-inch armor of the armored cruisers "Defense," "Warrior" and "Black Prince" were powerless against the German dreadnoughts and they also were sunk.

Meanwhile in answer to Beatty's wireless call the British battleship fleet was coming up as fast as forced draught could drive it. The first to arrive were the fast 25-knot 15-inch gun battleships of the "Queen Elizabeth" class, and we shall not be surprised to learn that these ships were the only British battleships to get into the fight. If so we have here another striking evidence of the great tactical value of speed, for it was the British battleships which turned the tide of battle, drove the Germans back and sent them in full retreat to the shelter of their mine fields.

That it was the "Queen Elizabeths" that turned defeat into victory is strongly suggested by the fact that the battleships which the Germans claim to have sunk—the "Marlborough" and the "Warspite"—are of this class. Both ships by the way returned to their home ports.

In their first announcement of the battle the Germans admitted the loss of only one capital ship, the "Pommern," though what this old pre-dreadnought was doing in the first dreadnought line is hard to imagine. She was believed to have been lost many months ago in the attempt of the German pre-dreadnought fleet on Riga in the Baltic. Was she lost then, and acknowledged now in place of a first line-ship—a dreadnought?

The list of German losses shows a tendency to grow. A dispatch from Berlin admits the loss of the "West Falen," an 18,000-ton dreadnought of the "Nassau" class. A strong suggestion of further losses in capital ships is found in Admiral Beatty's statement that while pursuing the German fleet he saw a German battle-cruiser blown up, that later he passed another battle-cruiser which was apparently mortally hurt, and that on returning he failed to find any trace of her.

There is a persistent rumor from neutral sources that the latest German dreadnought battleship "Hindenburg" was sunk, but neither the British nor German admiralty mention her, and at present the reports lack verification.

In capital ships of the first class then the British have lost three battle-cruisers and the Germans, a dreadnought battleship, one and possibly two (according to Beatty's report) battle-cruisers and a pre-dreadnought battleship.

In secondary ships the British lost three rather old armored cruisers and the Germans four new fast scout cruisers and two older cruisers.

Of destroyers the British lost eight and the Germans nine. The Germans also lost one submarine.

The total tonnage loss for the British is 114,100 tons, the tonnage loss for the Germans is 76,515, and if as Beatty's report indicates, two German battle-cruisers were lost, their total tonnage loss is 100,515 tons.

The British loss in capital ships is 63,000 tons, the German loss is 57,000 tons, or if two battle-cruisers went down it is 81,000 tons.

The outstanding fact of the Battle of the North Sea is that the British fleet engaged and drove the German fleet in flight back to its coasts, suffering in the engagement losses which so far as available information goes were equal to those of the enemy.

If the losses were equal the British fleet is to-day relatively stronger than it was before the fight—if its losses, as the Germans state, were heavier, the relative standing of the two navies remains the same. In the first case the grip of the British navy through blockade has been strengthened, in the second it remains as before.

From Herring to Halibut

Strong Measures Necessary to Keep American Fishermen from Being Driven off the North Pacific Banks

By Monroe Woolley

AS a big fish industry halibut is perhaps second to salmon in the vast fishing grounds of the Pacific Northwest Federal and State fisheries departments are taking unusual interest in this growing fishing field with a view to enlarging and marketing the catch.

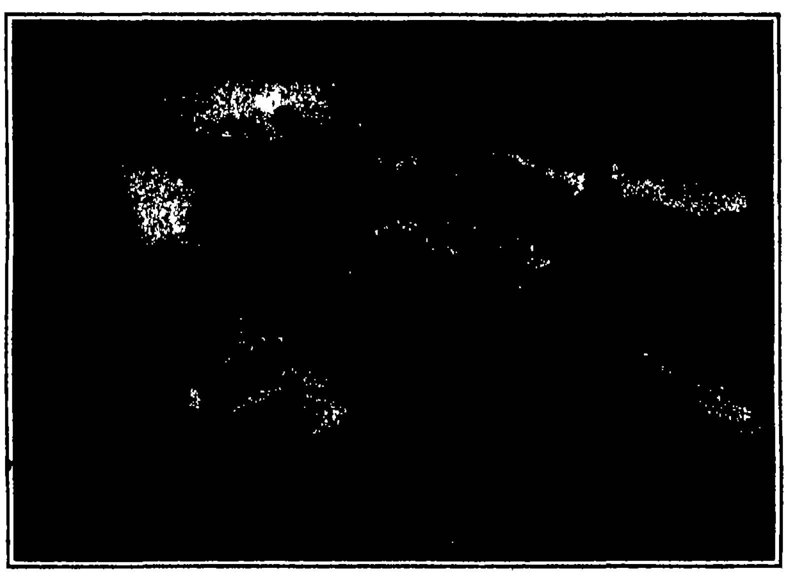
The halibut is the largest species of the flatfish family, or flounder A distinctive peculiarity consists in the fact that both eyes are on the same side of the head One side of the fish is colored, the other is almost snow white The halibut grows to great size, and often weighs from 300 to 400 pounds The meat is fat, tender and delicious, and there is a delightful absence of annoying bones Halibut steaks are especially appetizing But unlike salmon, halibut has not yet found its way into cans Therefore its market is limited, and citizens living inland rarely, if ever, meet it However, the halibut industry is growing rapidly, and as the fishing fields are enlarged, new ways of marketing the food are bound to follow, so that in time halibut may find its way into all parts of the country, without resort to refrigerator cars and other expensive methods of shipment

The Department of Commerce is doing all it can to keep the fishing industry of the North Pacific in the hands of American interests. Seattle has always been the headquarters and base of the American halibut fishing fleets, but as the bulk of the halibut is taken on banks in Alaskan waters, it is necessary to make a long sea trip to land the catches there Prince Rupert, British Columbia is 500 miles nearer the Alaskan halibut banks than is Seattle The completion of the Grand Trunk railroad has given the fishing interests a scare, for they fear Prince Rupert will become the halibut headquarters, not only for Canadian fishermen, but for Americans as well

Ketchikan, Alaska, has been used as a base by the Alaskan fishermen who wish to avoid the long haul to Seattle But Ketchikan has been quite unable to compete with Prince Rupert since the latter port has acquired railroad connection. Alaskan halibut fishermen have just appeared before State and Federal fisheries departments pleading for aid in saving their industry from destruction by Canadian competition But Secretary Redfield, according to press reports, had declined to suggest legislation putting a tariff on halibut imported into the United States from Canada

As their only means of salvation the Ketchikan business men have asked the Grand Trunk officials for terminal rates from Ketchikan to any point on the continent the same as charged from Prince Rupert If the officials agree to this request, and Prince Rupert will show the same consideration to American halibut fishermen as is shown the Canadians in the way of prices on ice and other supplies, it is possible that a part of our big halibut fleet will continue to make Ketchikan a home port, for Alaskan operations at least.

In any event Seattle is bound to lose much of the business heretofore brought by the Alaskan halibut fleets. To meet this situation the Federal Government has gone to much expense to locate new halibut fields nearer Seattle The Government steamer "Albatross," working with a crew of expert halibut fishermen aboard, has located new and extensive halibut regions off the Oregon and Washington coasts, close to American ports In 1915 nearly 1,000,000 pounds of halibut were taken from one of these areas New banks have also been discovered off the mouth of the Columbia River where none were supposed to exist, and certain other banks with commercial possibilities have been definitely located which were hitherto known only by rumor



Rough weather on the halibut banks

It may be said, according to official report, that a new source of halibut supply has already been developed, and that this same source will be of even greater value in the future for a supply of other fishes not now in demand. In fact, so good are these newly-found banks off Washington and Oregon that usually but from two to four days are required to fill the steam fishing schooners with cargoes. This halibut harvest comes to Seattle instead of to Prince Rupert, and hundreds of small halibut fishermen, and some of the steam fishers, have abandoned the Alaskan fields for the new ones off shore at home.

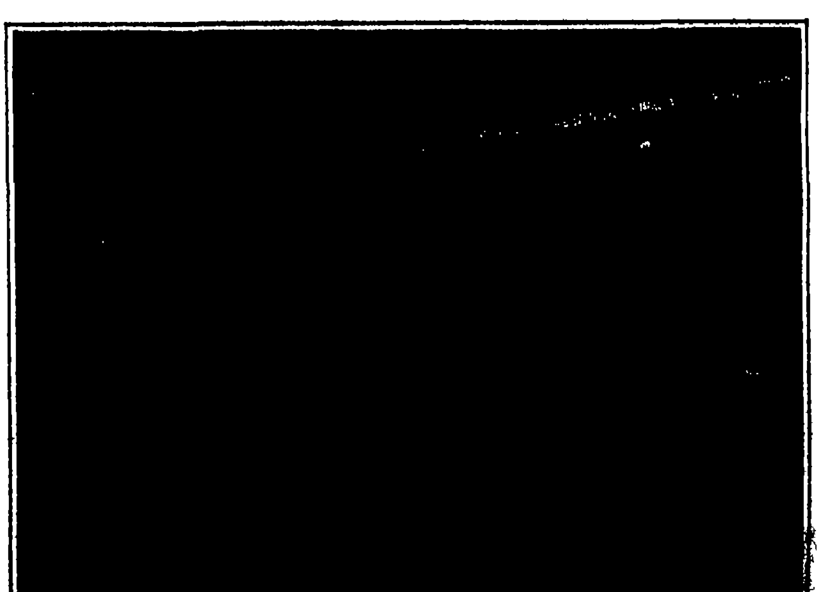
A movement is afoot to have the Federal Government continue these surveys for new halibut fields nearer home by chartering two regular halibut fishermen manned by their regular crews. It is claimed that these boats can do the work better and at a smaller expense than can the "Albatross." All the fishing industry wants Uncle Sam to do with the chartered boats is to determine the location and extent of shoal waters. The fisherfolk will themselves quickly determine whether halibut can be taken in commercial quantities, saving the Government the expense of this work.

At one time there were extensive halibut banks just outside Cape Flattery, but these banks have long since been fished out. Hence, halibut fisherfolk were driven to the bountiful, though distant fields, in Alaskan waters. The experimental operations of the "Albatross" in looking for new fields nearer American markets took the vessel 300 miles due west of the Washington cape, and thence south toward the mouth of the Columbia

If it were not for herring many of us would go halibut hungry, for it is herring, used for bait, which entices the halibut to take the hook and thus find his way to the butcher's block. This affords us our one advantage over the Canadians in the halibut fishing industry Puget Sound yields the best and biggest bait supply in the world Much of the herring bait for the entire halibut industry of the Pacific comes from this source Herring are taken largely in winter, and the catch is frozen to be preserved for use as bait in the summer Just now the fishermen are annoyed over a law which prevents their taking herring, even for bait, with seines. Overtures are being made to the Washington State Fish Commission to have this law modified

Halibut fishing is generally a dangerous business The fishing crews of the steam schooners operate in dories, much as the fishermen do on the Grand Banks about Newfoundland Their work takes them a long way from the ship, and frequently they are lost in storms and fog Some of the schooners engaged in the industry formerly operated on the Atlantic grounds, but some years since came to the Pacific Northwest, via Cape Horn, as a more fertile field Halibut usually brings the fishermen from 4 cents to 5 cents per pound, and a 400-pounder is thus worth from $16 to $20 Pulling up twenty-dollar gold pieces from the depths of the sea must indeed be exciting sport, but few of us will envy the brave men the reward they reap. If we did, competition might be keener

Cleaning the day's catch



Frozen halibut stored at Seattle

Halibut cannot be artificially propagated, as salmon can, because halibut deposit their eggs on the ocean bottom. Hence man has not yet found a way to rob them and incubate the eggs. For this reason, if harvested too freely, the supply may some day run out for a time. On this account, steps are to be taken to protect the fish by a closed season. Legislation will probably provide an ocean sanctuary, covering what has been determined to be the breeding grounds, in the Pacific Northwest.

The Current Supplement

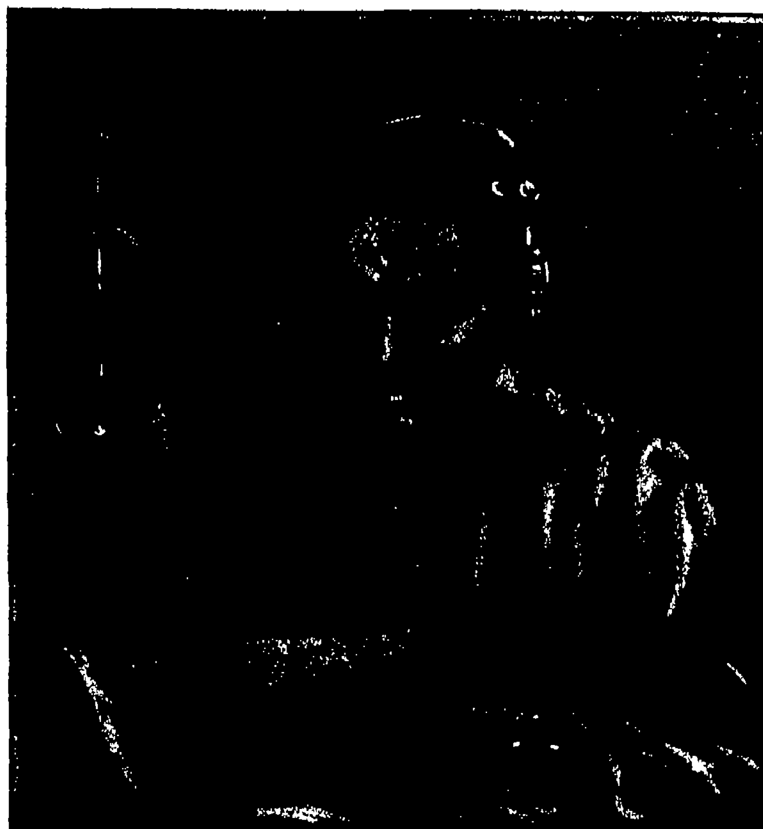
THE current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No. 2110, for June 10th, contains the fourth of the valuable articles on *Economy in Study*. These articles are of extreme importance not only to the teacher, but to everybody who reads, as the world of knowledge is now so vast that without systematic and scientific methods of acquiring information our field is discouragingly narrow. A short, illustrated article on *Locating Bullets in the Human Body* tells how the Roentgen ray is used for making the operation for their removal both simple and rapid, to the great advantage of the patient. Another war article on *The Mountain Gun and Mule Team* tells how light guns of special construction are transported in mountain country. The series of lectures by Sir J. J. Thomson on *Radiations from Atoms and Electrons* is concluded in this issue. *Good Roads and the Automobile* is a timely subject, and is illustrated by a number of excellent photographs. *The Noble Gases* tells how the nitrogen of a generation ago has been made to yield other elements of value to chemistry. These include Helium, Neon, Argon, Krypton and Xenon, some of which are as yet hardly known even by name to the general public. *Progress in Arc Lamp Technology* describes and illustrates a number of improved lamps that have been introduced abroad. *Mechanotherapy at Home* illustrates a simple exercising apparatus that is useful for preventing stiff joints resulting from wounds. It is also useful for general exercise. *Chemistry of the Amorphous Solid* is an attempt to generalize some of the mass of information that has accumulated in this branch of chemistry in recent years. *Invar and Related Nickel Steels* describes an alloy whose peculiar properties makes it of special value in the construction of scientific instruments. Another article of present interest is *Oils and Other Reagents in Flotation*, which deals with recent methods of concentrating ores.

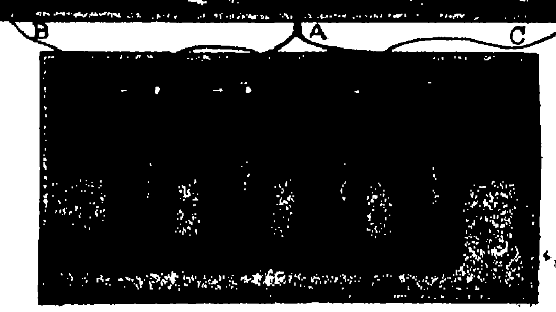
Experiments with Brines in Search for Potash

SEVERAL deep holes have been sunk in the deserts of Nevada, and one is being drilled in the panhandle of Texas under the supervision of the United States Geological Survey, in the search for potash. The Survey is also making some laboratory experiments designed to aid in discovering a cheap process of separating potassium salts from natural brines.

Since the importations of potash salts from Germany were stopped the urgent need of a domestic supply has greatly increased, and the price of high grade potash has advanced from $39 to about $500 a ton. Efforts to find commercially workable deposits in this country have been eagerly and diligently made both by private capitalists and public agencies. The Survey has endeavored both to find deposits of soluble potash salts and to discover practicable methods of extracting potash from rocks that carry relatively large proportions of potassium. Every clue that might yield valuable results has been followed up in a country-wide investigation extending from New York to California.

In the laboratory experiments special attention has been given to the evaporation of brines rich in potassium. The results of some of the earlier work were published late in 1915 as Professional Paper 95-E. More recent experiments have been made with the natural brine from Searles Lake, Cal., which contains the equivalent of nearly 12 per cent of potassium chloride in the solid salts. The results are given in a recent survey publication, "Evaporation of Brine from Searles Lake, Cal.," issued as Professional Paper 98-A. This report shows the changes in the composition of the crystals deposited from the hot solution during evaporation, and the composition of the crystals deposited when the solution was cooled. The data recorded indicate that carefully controlled fractional evaporation and crystallization, possibly combined with other treatment, promise much as a means of obtaining potassium from brines similar to that of Searles Lake. Further study of the behavior of the constituents of the brine under varying conditions may be made.

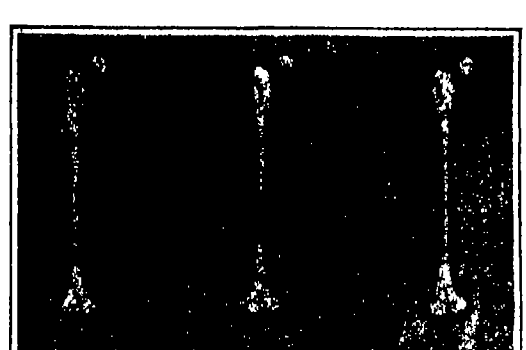




Apparatus for probing with a single needle

The electrical probe

(a) Fine steel needles. (b) Bullet. (d) Electric annunciator



Three shadowgraphs of the same bullet, from different angles, illustrating how deceptive the X-ray may be

A By-Product of the Sewer

CONSIDERABLE attention has recently been directed to a machine for drying sludge invented and patented by a firm in the Leeds district of England. It is claimed by the firm that this machine has made it possible to dry sewage sludge profitably, and that it is especially suitable for drying filter pressed sludge cake containing moisture in any proportion up to 75 per cent. In reply to inquiries the firm reports that the cost of converting 60 per cent sludge cake through the machine including interest and repayment of capital has been $1.94 per dry ton, while the fertilizer is worth $7.30 per ton and upward, according to the amount of ammonia it contains.

Electric Probes

Supplementing the X-Ray in Hunting for Bullets in the Human Body

By Robert G. Skerrett

MUCH as the X-ray has done to help the surgeon locate bullets or bits of shrapnel, etc., in the bodies of wounded soldiers, this penetrating eye of science is not infallible. The radiograph is, in fact, strictly speaking a shadowgraph and even when photographs of this sort are taken from two angles there is still a chance of misunderstanding. Shadowgraph geometry or surveying in a fog, as it might well be called, is not necessarily accurate for the doctor must still do a deal of guessing.

An X-ray apparatus is not unlike a candle in some particulars. It projects shadows according to the relative opacity of the substances through which it sends its beams and the position of these shadows in relation to one another depends upon the angle at which the light is placed. For instance, hold a ball by a thread in front of a blank wall upon which a vertical line has been drawn. Assume the ball to represent a bullet embedded in the flesh of a patient's leg and the line on the wall to stand for the single big bone of the upper leg. Depending upon where the candle is held, the shadow of the ball will shift in its relation up and down or to the right or left of the imaginary bone. So much for one of the difficulties of localization reduced to simple terms.

Again, since the bullet or piece of shell is extremely opaque compared with the texture of a bone the shadowgraph of the bone will always be lighter than that of the missile, and for that reason a single radiograph will not tell whether the projectile is in front of the bone or behind it. Two radiographs taken at right angles will help to solve this matter of location in a general way, but again, they will not indicate with certainty the distance of the metal object forward or back in relation to the picture plane. Instances have been cited where X-ray pictures had apparently localized the bullet, and yet after three hours of operating the missile could not be found by the surgeon. In military surgery time is too precious to permit anything like this.

The British military medical authorities have been using for many months two electrical aids to supplement the radiographs. One consists of two thin steel needles forming the terminals of an electric circuit. The circuit is closed when both needle points are brought against the embedded metal, and this serves to ring a little bell. The other, an adaptation of the telephone, is more ingenious and reduces by 50 per cent. the amount of probing required.

One end of the telephone circuit is secured to a small piece of platinum, and this disk, after the flesh has been moistened with salt water, is secured to the patient's skin by means of adhesive plaster. The other part of the circuit is in the form of a disinfected silver thread which is attached to the surgeon's instrument then in use—be that a knife, a probe, a needle or forceps. The moment the operator's instrument enters the flesh this contact produces a slight sound, but this is faint compared with the microphonic rattle that is heard the instant the scalpel or probe touches the metal embedded in the wounded man's body. It has been said that this telephonic aid to the surgeon has been of the greatest value, making it possible to limit to the smallest dimensions the operative wound and reducing to a minimum the time needed for the extraction of small foreign bodies.

Adhesion Tests for Fabrics in Rubber Industry

THE United States Bureau of Standards has installed in its rubber testing laboratory a newly designed autographic machine for testing the friction or adhesion between the different plies of canvas used in rubber hose, rubber belting, automobile tires, etc. This machine by means of a diagram that is made automatically during the test shows the exact value of the adhesion between the adjacent layers of fabric at all points. The machine was designed and built at the Bureau of Standards.

The Bureau is experimenting with several rubber compounds that have been made into eyeshades for use in connection with the range finders on battleships. Some of these shades have been molded in the Bureau's experimental laboratory and will be tested in service to ascertain the compound best suited for such use.

An important recent test was in connection with fire hose purchased for use in the District of Columbia. Samples representing 28,000 feet of fire hose were tested both physically and chemically to determine if the specifications had been complied with.

The Scientific American War Game in Miniature

By H S Gladwin

THE SCIENTIFIC AMERICAN war game series which came to a close with the issue of June 3rd has been put to practical use by Mr H S Gladwin. He has built a model of the terrain of the games on a plot measuring 40 by 50 feet and with an elaborate equipment of toy infantry, cavalry and artillery, has taught a group of young boys how military maneuvers may be conducted The accompanying photographs show the wonderful realism of the miniature war games They possess a fascination even for the grown-up, gray-bearded boy

Now that our war games have ended, we should be very glad to learn how they have been used by other readers of the SCIENTIFIC AMERICAN — EDITOR.

As a boy, while in England I derived a great deal of pleasure from the lead soldiers of English make which were sold as types of the British army comprising practically all branches of the service They were of better workmanship than any which I have seen elsewhere about 3 inches in height and being hollow, they weighed less and cost less than those usually to be found in toy stores

Two years ago my son being five years old I was fortunate in finding that one of the large department stores in New York had accepted the agency for these soldiers in America I at once began to lay in a generous supply against the time when my boy should become interested

The Infantry consists of Grenadiers, Highlanders, Territorials and the Worcestershire Regiment the Cavalry included Hussars Lancers Dragoons Scots Greys, Life and Horse Guards Artillery was made up of Royal Horse Artillery Royal Field Artillery and Mule Batteries Besides these I secured some Camel Corps Medical Corps Engineers etc

About March 1st of this year it occurred to me to ask five other boys aged from eight to ten to my house on Saturday afternoons to give them the use of the soldiers and by instruction and supervision to instill in their young minds the value and organization of the different units that go to the making of an army so that, in playing with their soldiers, it would be not so much a competition of destruction as of instruction

They were each provided with a regiment of Infantry consisting of 96 men, with a Colonel and Lieut Colonel mounted in command Their first day was spent in dividing this regiment into three Battalions of 32 men each a Major mounted, in command of each Battalion The Battalions were then divided into four companies of eight men each with a Captain in charge, the whole regiment being drawn up first in column of companies and then in column of squads.

The next two Saturdays were devoted to the security of a column on the march and each boy was taught to send out Advance Flank and Rear Guards

It was at this time that the War Game was begun in the SCIENTIFIC AMERICAN and I at once decided to utilize the information of the game to help instruct the boys We thereupon took the map of the terrain divided it into 20 squares of equal size and duplicated these squares on a plot of ground in my garden, 40 x 50 feet

The Neshaminy River was staked out, excavated to a depth of about 8 inches 3 inches of gravel were tamped into the bed of the river and then finished off with about 1 inch of sand and cement, mixed in the proportion of 3 to 1

The dirt from the river and Green Lake was used to make Lookout Mountain and Chester Hill, and the surplus sand and gravel we have since utilized for trenches and embankments Pine boards 1 x 6 dressed were used for roads, rough hemlock boards for the bed of the railroad We have reproduced the railroad with a 2 inch track and mechanical locomotive and train

The boys build the steel railroad bridges with Meccano, the stone bridges with Anchor blocks, and the wooden bridges are generally pontoon since they much prefer this type of construction. Incidentally, the planks of the pontoon bridges are 4 inch wooden garden labels, and serve the purpose very well The pontoons I made myself out of sheet tin, the scow shaped bow and stern requiring very little solder

The houses in Pottstown and in the villages are of cardboard and are to be found in all the department stores. They require a small stake, driven into the ground, to hold them in place and prevent their being blown away by the wind.

Our procedure on Saturdays is for my boy, usually with someone to help him to spend the morning in setting up the houses, tracks and incidental scenery so that, when the rest of us arrive at 2 30 everything is in readiness except the soldiers

I have reduced the time of the war game from days to hours, but no other change has been made

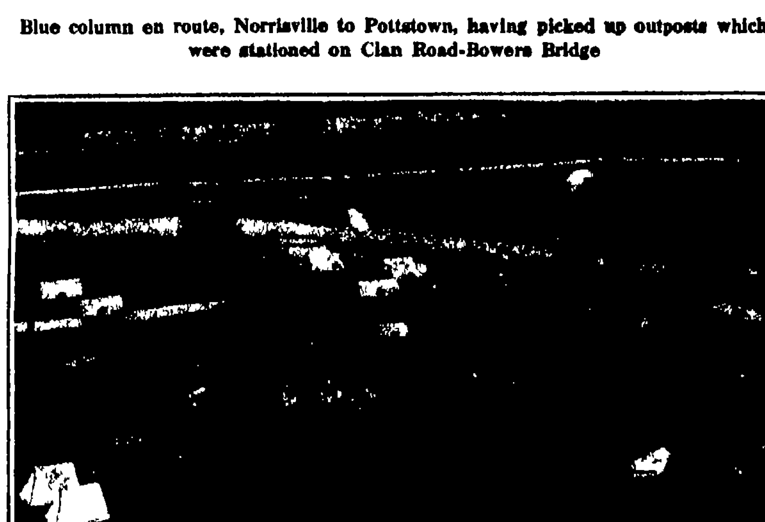
The map is laid out on a table, the boys divided into two sides, three on the Red, three on the Blue, and the Blue side remains by the table to receive orders and instructions During this time the Red side retires out of hearing While these orders are being executed the Red side receives its instructions and so on until the situation is completely developed.

When this point has been reached we hold a Council of War I attempt to explain the why and wherefore of the various movements of troops, pointing out particularly the necessity for supports and reserves and emphasizing the importance of outpost and intelligence service. I do not attempt to read the actual text of the War Game articles as they are not old enough to understand but we talk over the situation in language which is intelligible to them We then dismiss the war game and get down to the fighting stage of the combat

Each boy is equipped with a machine gun capable of firing 36 wooden shells attached to a tape These guns are sufficiently like the real article to exercise an unholy fascination for them The boys are stationed behind the miniature field guns in the positions that the War Game has dictated for them, and are only permitted to advance when the miniature batteries are advanced Should an advance be made without sufficient support,

(Concluded on page 627)

Blue column en route, Norrisville to Pottstown, having picked up outposts which were stationed on Clan Road-Bowers Bridge



The First Battalion of Blue Infantry having arrived at Lookout Mountain by train, the balance of the regiment advances from Pottstown

The main Blue detachment arrives in Pottstown

Looking southwest from Chester Hill

A group of water-ski enthusiasts. A double paddle is used as an aid in maneuvering the pontoons

New type of water-skis developed by Italian engineer, showing the paddle wheel used for propulsion purposes

Water Shoes for Sporting and Military Purposes

WALKING on water by means of water shoes or skis is not a new sport, but its periodic reappear ance in one form or another is always attended with in terest. This time the sport is suggested by an Italian engineer, who has evolved an ingenious form of shoe to which he gives the name "hydro ski."

The new water shoes or skis consist of two pontoons, one for each foot of the wearer just as with the ordi nary water shoes But the method of propulsion is decidedly unique and immeasurably more efficient than that of the majority of forms introduced in the past It has been the general practice to use ordinary pontoons which are manipulated in much the same manner as skis or snow shoes, that is to say first one foot and then the other is slightly raised and moved forward, resulting in a forward motion of the wearer However it is not so easy to secure a hold on the surface of a body of water as it is to secure a hold on snow, and hence this method when applied to water walking has been attended by laborious and slow progress unless the walker was unusually robust and skillful

In order to overcome the difficulties of water walk ing heretofore experienced, the present shoes are pro vided with two sets of cross arms to which paddles are fitted at their extremities It will be noted in the illus tration that one arm is held to one pontoon by means of a small shaft, while the other arm is held to the other pontoon in the same manner The shafts are not in alignment, so by an upward and forward manipula tion of each pontoon in turn the paddle wheel not only serves to give the necessary hold on the water but also rotates with sufficient power to propel the pontoons and their load forward at a fair rate of speed without undue exertion on the part of the water walker Steering and difficult maneuvering is facilitated by the use of a double-blade paddle

The Italian inventor, not content with introducing his improved shoes in the field of outdoor sports has made a number of experiments with a view to their adapt ability in military operations At the present time the outcome of these experiments is not known

Ernolith A New Celluloid Substitute

IT is only of recent years and largely owing to the researches of the Berlin Institute of Fermentive In dustries, that the very remarkable properties of yeast, aside from its levitating power have been realized Not only can valuable extracts be obtained from it useful as flavoring matter and for tonic and medicinal quali ties but it contains a relatively large percentage of protein, or albuminous matter Finally the mass of cellulose which constitutes its remaining constituent and which is composed of uncommonly tiny and delicate cells is capable of various reactions with other sub stances This latter property has been taken advantage of for the formation of plastic masses by combination with aldehydes. When these masses are subjected to heat under pressure a hard solid is obtained, known as ernolith which makes an excellent substitute for cellu loid ebonite, galalith bakelite resinite, etc

Two research chemists H Blücher and E Krause whose work is reported in the *Chemiker Zeitung*, have been able to vary the degree of hardness and elasticity of this product within certain limits The color which is originally black can also be varied by the incorpora tion of mineral or vegetable dyes so that shades of yellow, gray brown, red green and blue can be ob tained, as well as marbled or veined effects To the fundamental components of ernolith, yeast and alde hyde (particularly formaldehyde) other constituents may be added which cause a modification of the chem ical and mechanical properties

The process of manufacture consists of two phases first the union of the yeast and the aldehyde (with various "fillers" and subsidiary reactions) The mass thus obtained is dried and ground and in this form is indefinitely durable This powder is known as a half fabricate" or "raw ernolith The next step is its com pression in heated hydraulic presses The articles thus obtained are said to reproduce on their surface the most delicate details of form, such, for instance, as those of relief maps, etc

Aside from this capacity for being directly molded, ernolith is capable of being sawed, filed, bored turned engraved, ground polished and otherwise mechanically acted upon It has an exceedingly close dense struc ture and a conchoidal fracture As remarked, the process of manufacture may be so varied as to make the product very hard and brittle, or softer and more elastic, as may be required It possesses a very de cided advantage over celluloid in being almost entirely uninflammable, being very difficult to char Another excellence is the economy of production since the raw powder may be precisely measured thus avoiding scraps and trimmings Its specific gravity, when pure (i e without fillers) is 1 33-1 35

Among the many objects for which it may be used are door handles window attachments, handles for knives, tools, etc bas reliefs and other sculptures, card plates lamp-bases, picture frames, mural decorations, etc as well as innumerable articles in fine mechanics and technology

Ernolith also has the quality of adhering very tightly to metal threads and tissues pressed into it This makes it highly adaptable for making articles when a metal surface or core, as in buttons, or door handles, is to be united with a composition As primary mate rial, it is possible to employ not only the ordinary waste yeast of breweries but also the "air made" yeast of the Delbrück process

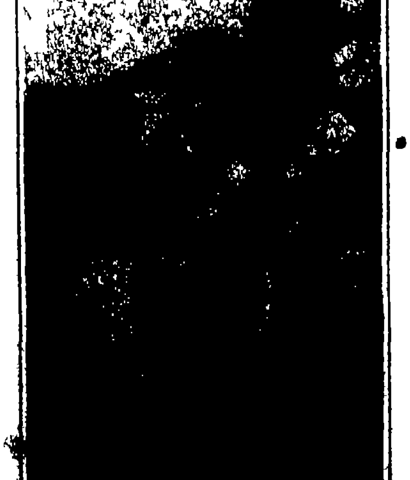
Purifying Swimming Pools

COPPER sulphate in small amounts is more suitable for purifying public swimming pools than is calcium hypochlorite or bleaching powder The latter loses its efficiency with use and is irritating to eyes and mucous membranes None of these objections holds with the blue vitriol

Improvised Submarine Made from Odds and Ends

THE one man submarine shown in the accompanying illustrations embodies no new principles of construc tion but undoubtedly represents a most economic appli cation of old ones The wash boiler when inverted and filled with air has just sufficient buoyancy in water to sustain a 100-pound sack of hardened cement The crew sits on the rock until enough air escapes to allow of sinking The imprisoned air that remains can be breathed several times and will allow a good swimmer to remain under water for a period anywhere from 10 to 15 minutes A line fastened to a lard-can float acts as a signal to an assistant on the surface who increases the buoyancy of the diving bell by forcing more air down to it through a garden hose with a bicycle pump and brings the submarine and its crew to the surface

The U 23 was hastily assembled to meet an emergency in time of peace and the inventor looks with extreme disfavor on proposals that it be equipped with torpedo tubes or used for war purposes in any way



Making final adjustments on the home-made submarine before a journey

The improvised submarine boat in dry dock after a successful cruise with her one-man crew

The mechanism of the home-made submarine and how it is arranged

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Using a Phonograph in an Automobile

THE utility of the motor vehicle is being demonstrated in new and interesting ways every day. The latest illustration of this brought to our attention is to be found in a letter recently written by Mr. Arthur Brisbane, the New York editor, to the manufacturer of his car, in which he says:

"I write this on my way to Hempstead from my office in New York. I have installed in my car a phonograph, resting on a cushioned box which I have devised. The car is going a little over 30 miles an hour, as I glance at the speedometer on the average Long Island road. And I am able to utilize the time on the way home working writing—a great saving, and one that I believe will be of vast importance to business men. When you talk to business men about the use of an automobile, point out to them the fact that taking a car to and from the city is no longer a luxury but common sense economy of time. The car adds two (working) hours to my day, and two working hours in the fresh air. The sum total of hundreds of millions of hours that working Americans spend in their automobiles can now be made useful—the best hours of the day. To work in a car with the window open, fresh air pouring in, no interruptions from the telephone is indeed a luxury, and a productive luxury, which is the only good luxury."

Since the letter was written, the recipient, at Mr. Brisbane's invitation drove out to the Edison laboratory in the editor's car for the purpose of showing the device to the famous inventor. To say that he was delighted with Mr. Brisbane's ingenuity in utilizing the phonograph in such an original manner would be putting it mildly. He not only watched the process of dictation into the machine, but, as shown in our illustration, tried the experiment himself.

Thomas A. Edison dictating letters in an automobile

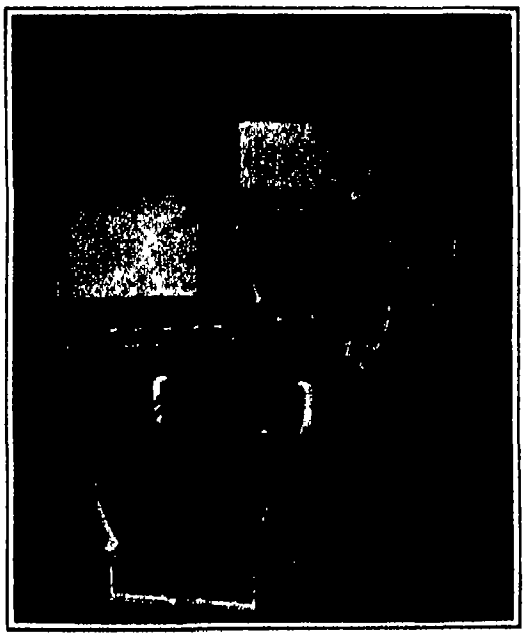
A Device Which Makes Broiling or Roasting Simple

THE problem of successfully reversing a piece of meat held in a gridiron or analogous device, so that a new side may be presented to the direct heat of the flame of a gas stove, has been solved in a recent invention. Not alone that, but the distance between meat and flame can be instantly varied by the simple manipulation of a lever. Credit for the invention, which thus simplifies broiling or roasting to a material degree, belongs to Henrietta W. Lawrence of Baltimore, and Harry J. Lebherz of Frederick, Md.

The reversible broiler, as it is called, consists primarily of a simple cast frame in the form of a double crutch, the two ends of which are joined and held together by suitable cross members. The frame terminates at the top in small shoulders, which are provided with notched levers or pawls. The meat to be broiled or roasted is placed in a broiler rack or gridiron that is hinged on one side and provided with suitable clasps at the other. It opens in much the same manner as a book to admit the meat between the two covers, after which the notched clasps are used to firmly close the members. The clasps are provided with a plurality of notches in order firmly to grip meat of varying thickness between the members. The gridiron is also provided with a handle in the center of one end by means of which it can be manipulated.

Returning to the frame it will be noted in the accompanying illustration of the device that on either side is a hinged, shelf-like projection. These members are, in reality, bearing members serving to engage with the shelf or pan holders or ledges found in the oven of practically every standard gas stove. By the manipulation of a lever (not shown in the illustration), the wing-like members may be withdrawn from the ledges in order to raise or lower the entire frame with its gridiron without removing it from the oven. Thus it is possible to vary the distance at will between the flame and the article that is being cooked.

To reverse the meat in the gridiron, the handle of this member is taken with one hand, while the other hand moves a long lever at the left of the frame, which causes the left hand pawls or notches, holding members at the top to release one side of the gridiron. The free end of the latter then swoops down, traveling on the crotch frame which acts as a track, and when it has reached the bottom the handle is given a sharp twist, disengaging the right-hand side of the gridiron from the pawls and swinging it over to the left-hand pawls. The handle is then turned still further, bringing the present free end of the gridiron into engagement with the right hand pawls, thus completing the reversing operation. Naturally, all this occurs in a fraction of a minute's time, and is quite simple.



The reversible broiler and how it is used in the oven of a conventional gas stove

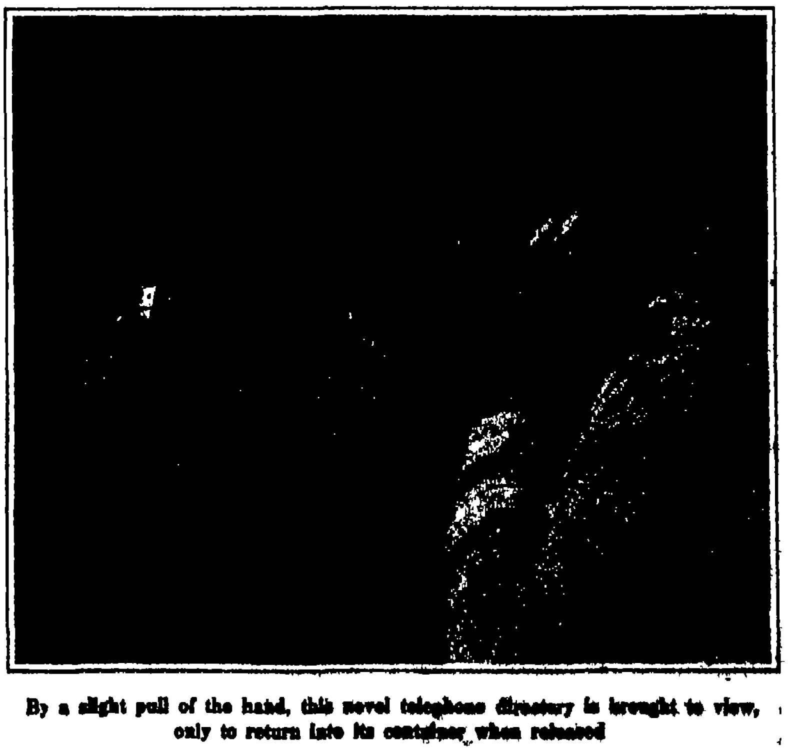
The frame is glazed inside so that the drippings from the meat can be collected on a plate placed below it. A slot is cut through the bottom of the frame for the purpose, and in a recent form the frame is provided with hooks for holding a plate.

A Telephone Directory that Operates Like a Window Shade

BY employing the principle of the conventional window shade, an American inventor has developed a telephone directory of novel design. It is so constructed that a flexible strip upon which the information is tabulated is retained within a cylinder, protected from dust and injury, and is available at a moment's notice by the slight pull of the hand. The strip is returned automatically to the cylinder as soon as released, after the reference is completed. The containing cylinder, as will be noted in the accompanying illustration, is fastened to the usual desk telephone instrument by means of a suitable clamp.

The strip of the new telephone directory is made so that printing, typewriting, hand writing, or any other form of information, may be clearly shown upon it. The material used in the curtain is a form of tough, glazed cloth, which winds on a spool within the cylinder. A slot at the top of the spool engages with a pin carried by the shaft of a small spring which has sufficient strength to return the curtain onto the spool and normally keep it there. By turning the cap at the top of the cylinder, which contains the spring member, more or less tension can be applied on the curtain. The free end of the curtain terminates in a handy, hollow metal rod for holding purposes.

When additions or changes are to be made to the telephone directory, the curtain can be readily removed from its spool and end piece. By an upward pull on the top cap of the cylinder the spring member, spool and curtain are removed, the two latter being suspended from the spring cap. The curtain is then freed from its spool by pulling off one of the ends of the latter, which exposes the end of a slot that serves to hold the curtain, and sliding out the last mentioned member. In much the same way the other end of the curtain is removed from the metal rod by pulling out a tapered metal plug and sliding out the curtain through the end of the retaining slot. The curtain is finished off at both ends with welts, which serve to hold it securely in the slots.



By a slight pull of the hand, this novel telephone directory is brought to view, only to return into its container when released

Wanted—A Trade Mark

AN offer of a thousand dollars in gold for the best original design of a trade mark has been made by the Western Union Life Company of Spokane, Washington. The contest closes on October 15th, 1916. Particulars may be had of the company at the above address.

Legal Notes

Electrical Transmission of Images.—Eliot Keen, of New York City, in three recent patents, some of which are assigned to the Telegravure Company, a corporation of New York, discloses some interesting improvements in electrically transmitting pictures and photographs to distant points and successfully reproducing the images at the receiving end. By his improvement the inventor reduces the picture to a half tone plate of novel characteristics for the sending end, and secures a transformation of the telegraphed record into a substantial dupli-

(Concluded on page 636)

LEGAL NOTES

(Concluded from page 624)

cate of the original picture at the receiving end. He claims to have overcome the heretofore insurmountable difficulty of securing that degree of synchronism between the sending and receiving machines required by prior improvements in this line and to provide an apparatus by which using a half tone cut or its equivalent he produces and transmits a series of electrical impulses proportioned to the size of the several dots composing the half tone in such manner as to reproduce a half tone picture of exactly the appearance of the original half tone.

Limitation of Amendment After Opposition — In D H Burrell & Co. vs Simplex Electric Heating Co. in a second opposition the Court of Appeals by Mr Justice Robb said "After an applicant has been defeated in an opposition proceeding he may be permitted to amend his application, but he must eliminate therefrom every ground of controversy which was involved in the opposition proceeding, for unless he does so that proceeding is rendered abortive and a second controversy started over a question that the prior decision put at rest"

Danger of Delaying Patent Applications —The Court of Appeals in affirming the decision of the Commissioner in re Pope suggests that,

'Though it is true that a patent may not be withheld because of delay authorized by the statute, we agree with the Commissioner that an applicant who has prolonged his application for a period of years knowing that the device covered thereby has gone into public use, is not in a position to demand more than is strictly due him In such a situation the Commissioner would be fully justified in reversing the ordinary rule by resolving doubts against the applicant"

The "American Girl" Trademark Case —In Hamilton Brown Shoe Co vs The Wolf Brothers & Co the Supreme Court in a decision delivered by Mr Justice Pitney in over ruling the decision of the Circuit Court of Appeals does not regard the words "The American Girl' employed in connection with shoes as being a geographical or descriptive term, but holds that it does not signify that the shoes are manufactured in America or intended to be sold or used in America nor does it indicate the quality or characteristics of the shoes "Indeed," the Court said, "It does not, in its primary signification indicate shoes at all" Having held that the complaint is entitled to the use of the words "The American Girl" as a trade-mark the Court held it entitled to the profits acquired by the defendant from infringing sales under the label "American Lady" to the extent that such profits were awarded by the decree below amounting to hundreds of thousands of dollars, probably the largest judgment ever awarded in a trade-mark infringement suit.

Making Railway Rails Continuous by Means of the Electric Arc

(Concluded from page 617)

ages 100 bonds per day and is carried about on a car Its crew comprises four men, a bonder and three helpers The car, which is 6 feet 10 inches long by 5 feet 10 inches wide, carries an 18-kilowatt rotary converter and transformer, with the necessary apparatus for welding operations As would naturally be expected, welding outfits are made in a wide variety of designs and sizes, so the apparatus just mentioned can only be considered as one example

To weld an average sized rail bond to a rail an alternating current of 2,000 amperes at 5 volts is employed On direct current railroads the required current is obtained by converting and transforming about 20 amperes at 500 volts taken from the third rail or trolley wire. As a general rule, the welding current should not exceed a potential of 25 volts at the arc. In its crudest form an arc welding outfit may make use of a water resistance for reducing the current to the desired po-

LEGAL NOTICES

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Scientific American (established 1845)	$3 00
Scientific American Supplement (established 1876)	5 00

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application

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tential, but since this procedure is extremely wasteful of power, a rotary converter is preferred, not only because of its efficiency, but also on account of the better regulation obtainable The welding tool proper consists of a simple holder carrying an electrode of carbon or metal, the former is used for cutting or heavy current welding, while the latter is employed to build up or fill cavities In some instances the electrodes combine a flux which prevents the metal parts of the work from oxidizing, but in actual practice this provision is found to be unnecessary

The amount of current required for any given work varies to a great extent because of the many factors involved It is seldom that welding operations can be conducted with less than 50 amperes and currents as high as 150 amperes are not unusual in ordinary instances However in the case of thin sheets currents as low as 15 amperes may suffice On extra heavy work 150 to 200 amperes may be necessary The foregoing figures are for metal electrodes, graphite arc welding averages 350 to 500 amperes on general work, and 100 amperes on small work to 600 amperes on unusually heavy undertakings Carbon arcs which are employed in cutting operations, require anywhere from 300 amperes on small sections up to 1,000 amperes or more, with an average of 400 to 600 amperes

Expansion and contraction of street car rails are taken care of in the welding of the rails Generally the rails are not absolutely welded together, a strip or other connecting member being welded to each rail so as to form a homogeneous connection So intense are the heat and light emitted by the electric arc that the worker must protect himself by wearing a heat resisting mask provided with a colored glass window, and a heavy pair of gloves, as illustrated in the front cover illustration of this issue

The Scientific American War Game in Miniature

(Concluded from page 622)

in our case 30 Cavalry or 64 Infantry for a battery of four guns, or should this support be appreciably diminished by the enemy s fire the boy who has caused the advance is subject to capture together with his miniature battery Such a denouement at once causes the wildest rejoicing on the one hand and the blackest despair on the other

We are formulating new rules for this supplement to the war game as we go along but I have hesitated to complicate them with too many restrictions I have never seen boys enjoy themselves more and am constantly surprised at the amount of information which they have absorbed At the same time I have no hesitancy in saying that I enjoy my Saturdays just as much as the boys do and look forward to them with just as much pleasurable anticipation

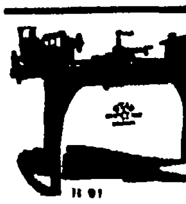
NEW BOOKS, ETC.

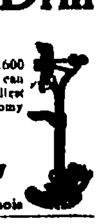
THE IRISH AT THE FRONT By Michael MacDonagh New York Hodder and Stoughton, 1916 12mo , 158 pp Price, 75 cents.

To this narration of valorous deeds John Redmond has written a delightfully Irish introduction One should read the book first, or he may deem the introduction too enthusiastic having read the book, he may no longer deny that all the enthusiasm and all the pride are amply justified. We are told how the Munsters saved the guns in the retreat from Mons, how the Irish Guards rallied to the green flag at the Marne, how the Liverpool Irish dared the asphyxiating gas and liquid fire, how the 7th Dublins gallantly stood and gallantly fell in the fight for Kislah Dagh and how the London Irish made their historic football charge at Loos with the German trenches as goal.

TRADEMARK POWER An Expedition into an Unprobed and Inviting Wilderness By Glen Buck Chicago Munroe & Southworth, 1916. 8vo , 112 pp., illustrated.

The value of the trademark in advertising is now generally, if not fully appreciated Psychologically, it is vindicated by the tenet that what compels the eye is more stimulating and tenacious that what assails the ear pictures came before letters, and the juvenility that is so large a part of the normal human makeup quickly responds to a striking picture or design. The elements of appeal in the trade-





mark cannot be reduced to exact principles that may decide all cases, but in one respect Mr Buck's sprightly contribution furnishes a welcome first-aid, this is in showing manufacturers and designers what to avoid with this are offered ideas well worth considering and considerations decidedly worth weighing. The reader cannot long follow these without recognizing the fact that human nature and the trademark are very closely related elements of the advertising art, or without gaining the impression that only a clean cut, distinctive symbol can carry a product on to success.

THE LOCOMOTIVE. Vol XXX Hartford Conn The Hartford Steam Boiler and Insurance Co 8vo, 159 pp., illustrated.

This bound volume The Locomotive" contains the issues of that bright little quarterly from April 1914, to October, 1915 It pictures, describes, and comments upon such boiler explosions as are of interest from their unusual violence, or from the lessons they may convey points in boiler practice form the subject of brief articles such allied devices as steam gages, and such operations as autogenous welding, are discussed with frequent remarks on inspection methods and various other topics of interest to the manufacturers and user of boilers The element of safety is of course the keynote of the publication

PRACTICAL ELECTRICIAN COURSE. 3 Volumes Prepared by Extension Division of School of Engineering of Milwaukee By Oscar Werwath E E, Geo J Kirchgasser, E E, Frederick C Raeth and W E Hennig Milwaukee Electroforce Publishing Co 8vo Book I, First Principles of Electricity 100 pp, 117 illustrations. Price, $1 25 net. Book II, Theory of Direct Current 78 pp 95 illustrations Price, $1 net Book III, Electric Light Wiring. 120 pp, 184 illustrations. Price $1 net.

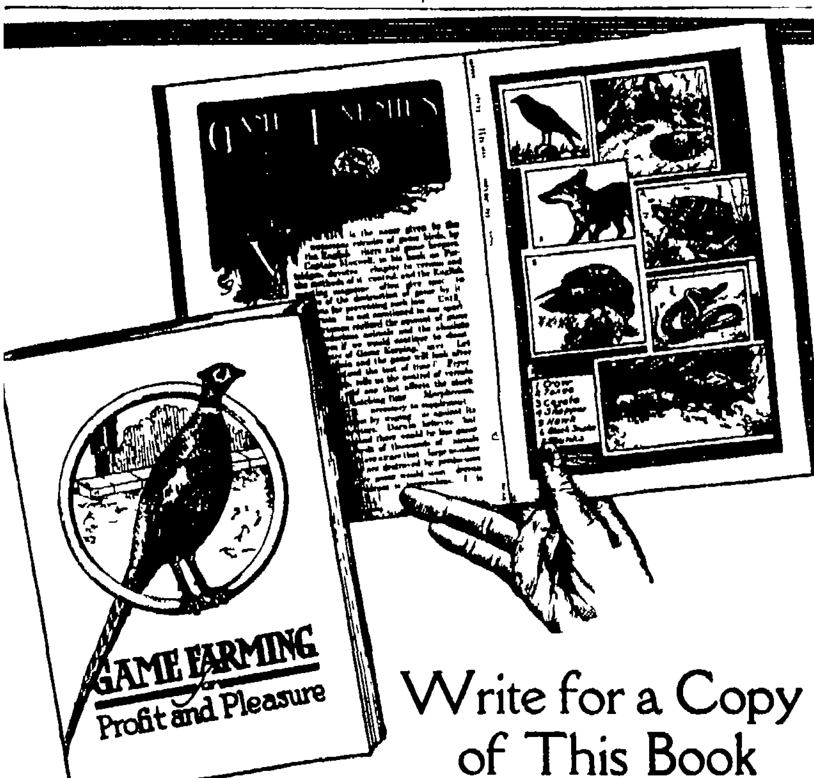
In the 'First Principles of Electricity' are concisely stated the fundamentals of electrical knowledge, particularly in connection with such common devices as bells, burglar and fire alarms, self winding master clocks, and the telegraph In the "Theory of Direct Current" appears an explanation of series circuits, multiple circuits electrical power resistance, and electro-heating. "Electric Light Wiring" discusses direct and alternating currents insulation and capacity of conductors, interior wiring systems, and fittings and accessories laboratory experiments are given and there are chapters on sign lighting and electric illumination These three volumes together with two others— Magnetism and the Commercial Application of Magnets' and 'Telephony,' constitute Section I of the Course which is the outgrowth of a decade of actual experience in teaching and is excellently adapted not only for school use but also for self instruction Simple diction and a regard for the commercial application of all principles characterize the work, which in succeeding sections will deal with the further uses of electricity in their relations to manufactures and industry The aim is to furnish a comprehensive and thorough library and if the same high standard as is evident in these first three books is maintained, that aim is already an accomplished fact.

AN ELEMENTARY MANUAL OF RADIOTELEPHONY For Students and Operators By J A Fleming, M A., D Sc, F R S Longmans, Green and Co, 1916 8vo, 300 pp, illustrated Price, $2 net.

The author assumes on the part of the reader an elementary knowledge of electrical science although the present text is addressed to a wider public than his former volume on the Principles of Electric Wave Telegraphy and Telephony Its material is well suited to the student, the operator, and the general reader who is interested in the subjects of which it treats Historical matter is subordinated to more directly useful instruction which shall fit the student for more advanced investigation This is a third edition of the work, with corrections and additions that bring it up to date

THE MENTAL LIFE OF MONKEYS AND APES. A Study of Ideational Behavior By Robert M Yerkes, Harvard University New York Henry Holt & Company, 1916. 8vo, 145 pp, six plates and five text figures Price, $1 50

Our literature of the behavior, psychology and sociology of the infrahuman primates is deplorably incomplete and inadequate. In this monograph is recorded a number of experiments whose results must contribute largely to a better conception on our part of the mental life and possibilities of monkeys and apes. It is the author's conviction that this study and the knowledge it supplies would directly aid in the solution of many problems of experimental medicine, of physiology, genetics, psychology sociology, and economics, and should lead to decided improvements in our educational methods. The "Behaviour Monographs" constitute a series of peculiar interest from many points of view, and this one, with its multiple-choice experiments and its supplementary tests of ideational behavior in animals so closely related to man, [illegible]



SCIENTIFIC AMERICAN

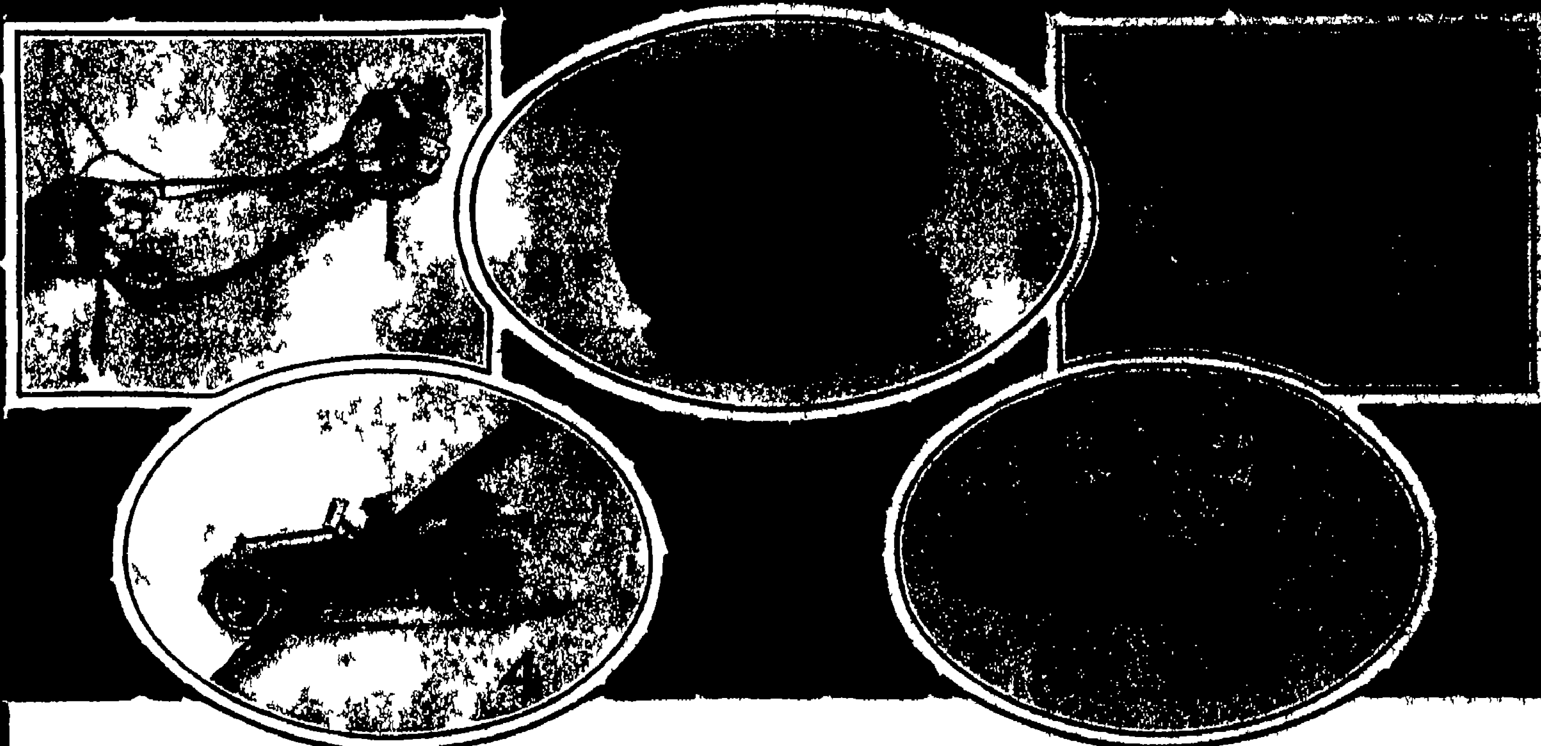
BRITISH FLEET IN ACTION OFF THE COAST OF JUTLAND.—[See pages 640-641]

June 17, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

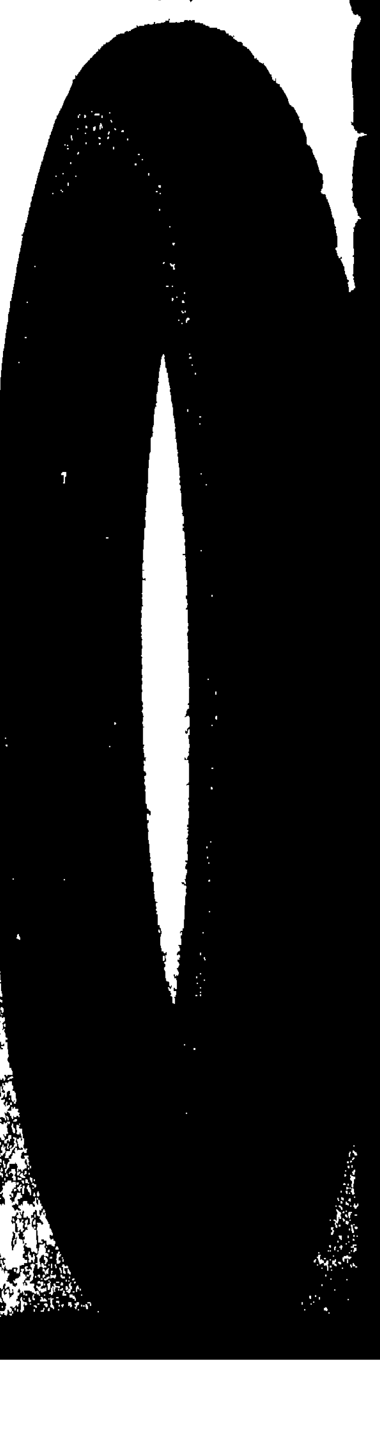
Price 10 Cents

Why tires wear out too soon



Five disadvantages of rubber—and how the Prodium Process minimizes four of them

Aside from poor fabric and poor workmanship, tires wear out prematurely for five reasons. (1) Lack of tensile strength in the tread rubber. (2) Uneven wearing down of the rubber, causing irregular worn spots and holes. (3) Chips and cuts that admit water to rot the fabric. (4) Heat caused by friction, and (5) under-inflation.



Nothing but the regular use of a tire pump or air tank will remedy the last The other four are reduced to a minimum by the Prodium Process, a wonderful new discovery in compounding tire tread stock, owned and controlled exclusively by The Republic Rubber Co. Here s how Republic Prodium Process Tires solve the four problems.

1 Wonderful Tensile Strength
Laboratory tests show Prodium Process Rubber to be much stronger than ordinary rubber A strip one inch thick will hold 3 400 lbs or 20 average men

2 Uneven Wear Eliminated
Prodium Process Tires wear down as evenly as a piece of fine steel The cut above is a section taken out of a tire that has gone 9 467 miles Note the thick tread still remaining

3 Chipping and Cutting Reduced
Prodium Process Rubber is the toughest rubber we have ever tested Illustration No 3 shows the kind of tests we give this wonderful material Even fresh cut rock does not chip or gash it

4 Heat and Friction Overcome
Heat comes principally from friction, friction from slippage Prodium Process Rubber has remarkable anti-skid qualities, and will stand a higher temperature than ordinary rubber

Buy one Republic Prodium Process Tire and check its mileage—observe its condition from week to week Your odometer record and your own eyes will substantiate every statement made above

Free sample of Prodium Process Rubber

Write for a piece of this new material ⅛ inch thick Pull it! Jerk it! Try to break it! We have found few hands that can tear this slender strip.

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REPUBLIC PRŌDIUM PROCESS TIRES

STAGGARD, PLAIN, AND "WM" TREADS

TRADE MARK REGISTERED U S PATENT OFFICE

Made in the Stylish Black Tread

SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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One of the tasteful bridges at Sheppard's Dell

Crown Point, on the Columbia Highway and its grand panorama

A Beautiful Link in Our Highway System

ONE of the most attractive additions that has recently been made to our new system of good roads is the Columbia Highway that extends from Portland, Oregon, to Hood River, a distance of 60 miles, for while it is not conspicuous for its length it more than makes up for this in the variety and charm of its scenery This new scenic route along the south shore of the Columbia River was begun in 1913, and it is expected that it will be entirely completed by August of this year, but the greater portion of it is so far advanced that it is now open and in daily use, hundreds of sight seers and pleasure seekers passing over it every day in automobiles

For many miles after leaving the city of Portland the road leads through a charming farming country until the Columbia River is finally reached at Crown Point, a bold elevation 700 feet high that stands directly on the river bank and affords a magnificent view of the river, and a panorama of the surrounding country including an area of from 30 to 40 miles Here space has been arranged to allow tourists to stop conveniently and enjoy the scenery without obstructing other travelers, and a promenade has been constructed of concrete around the brow of the bluff

From this point onward the scenery is both varied and delightful, for many small streams, flowing down the steep mountains to the river, form exquisite cascades and water falls, some of which are visible to the traveler on the main road, while others are made accessible by specially constructed foot trails and tasteful masonry bridges.

It has been necessary to provide a number of bridges on this stretch of highway, most of which are of reinforced concrete construction, and great care has been taken in designing them to produce pleasing and harmonious structures in keeping with their location and surroundings. One of the larger of these bridges, at Shepperd's Dell, is shown in one of the illustrations and indicates great good taste on the part of the engineers

The show place of the undertaking however, is the unique tunnel at Storm Cliff, or Mitchell's Point as it is sometimes called At this place a barrier was encountered by the road makers in the form of a solid basaltic cliff that arose abruptly from the river Along its base a railway occupied all of the available space, while the old road that ran through this region climbed painfully over the crest some 2,000 feet high, by long and steep grades A tunnel appeared to be the logical solution of the problem and, possibly having in mind the famous Axenstrasse, in Switzerland, the engineers arranged their plans in a similar manner, cutting a series of great windows in the outer wall of the tunnel that give some magnificent views of the nearby river

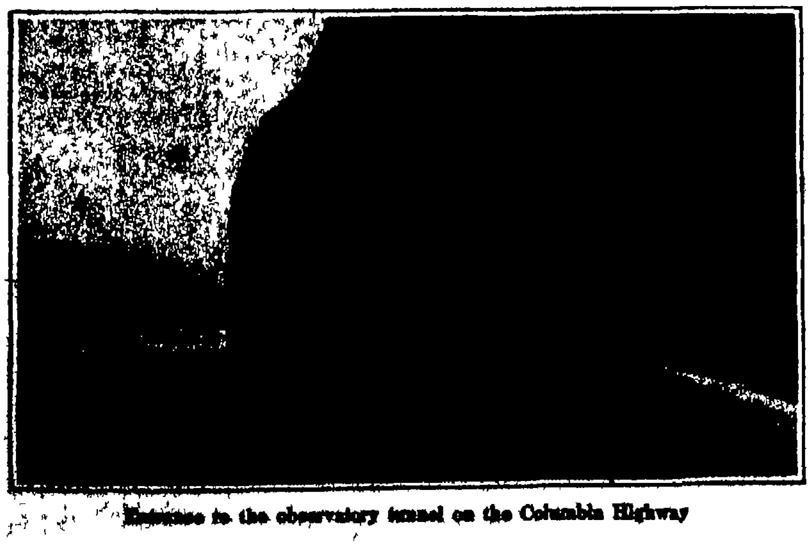
From the river the ledge arose about 500 feet, where there was a bench, or saddle of a few hundred feet in width, and above this bench the rocks extended up fully 2,000 feet more From this bench men were lowered by ropes to blast out niches for the use of the surveyors in running their levels, and later on the contractors followed to hew out the opening for the highway a tunnel 18 feet wide, 19 feet high and 400 feet long The windows, seen in one of the illustrations, are approximately 20 feet wide and 10 feet high, with substantial protecting railings of reinforced concrete The approach to the tunnel from the east is by a viaduct of reinforced concrete 200 feet long, that spans a rocky gorge on the flank of the cliff

This tunnel at Storm Cliff is but one of a number of openings that were cut through the projecting shoulders of the rugged hills, extending along the banks of the river for many miles in this region and lending distinction to this stretch of highway

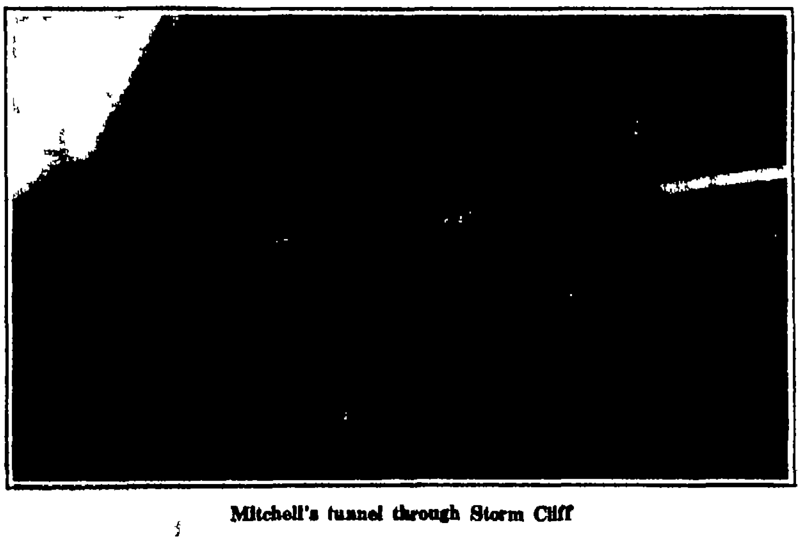
As has been said this new piece of modern road is 60 miles long, and for its entire length it has a fine bitulithic surface 18 feet wide In no case is the grade greater than 5 per cent and it is claimed that this road equals, both in construction and scenery, anything of its kind in the country

At Hood River where the present section of the Columbia Highway ends, connection is made with old existing roads that form a route eastward to the Missouri River, midway between the proposed National Parks Transcontinental Highway as suggested by the National Parks Highway Association and endorsed by the National Highways Association and the Lincoln Highway Connection is also made with the latter route at Salt Lake City so that, while no suggestion has as yet been made of such a long extension, it is evident that such an extension of the good road would be of great convenience to those who come west over the Lincoln Highway and who desire to continue to the coast at Washington or Oregon

Undoubtedly the inception of the great systems of national highways that are being widely promoted lies in the rather selfish desire of the automobile tourist for more and new territory that he can cover conveniently and comfortably with his car Still whatever the inspiration every mile of modern road that is built demonstrates its economical value to the farmer and the merchant and promotes a good work that is of the greatest importance in the promotion of the welfare and progress of the entire country There is however, one side of the good roads movement that is disappointing and which, apparently, must be learned by expensive experience and that is the matter of maintenance Because a road is elaborately and substantially constructed it is too generally expected that it will last forever, and consequently it is neglected until entire reconstruction is necessary Constant and systematic supervision and the prompt repairing of the slightest defects as soon as discovered is an essential to permanent good roads, and moreover, is far cheaper in the end than costly rebuilding



Entrance to the observatory tunnel on the Columbia Highway



Mitchell's tunnel through Storm Cliff

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Russia, the Ultimate Decisive Factor in the War

A FORMER officer of high rank in the United States Army, who has spent a large part of the past two years on the French, British and Russian fronts, where he was in intimate association with the High Command, and is therefore thoroughly conversant with conditions, informs us that it is his conviction that the war will last two years longer, and that the decisive stroke in favor of the Allies will come from Russia.

For obvious reasons the name of this gentleman is withheld, but we are permitted to give verbatim his estimate of the situation, which is as follows: "It is my matured military judgment that the combined technical organization and resources of Great Britain and France cannot drive Germany out of Belgium and France; but I do believe that they can hold—that they can resist the drive on Verdun or any drive on Calais and can prevent the investment of Paris. All they have to do is to maintain the line until Russia is fully organized and equipped. I believe that the treaty of peace will be signed in Berlin, but not this year or next."

As regards the western front, France, according to this authority, has with the colors to-day close to 4,000,000 men, fully equipped, England, also, has fully equipped at least another 4,000,000, but the British forces are somewhat scattered, large contingents being in Mesopotamia, Egypt and Saloniki. Nevertheless, she has to-day in France over 1,600,000 men. Of these, 1,200,000 are holding from 60 to 70 miles of the western front extending from the Belgian army far down into France. Back of Verdun are massed not far short of half a million British troops, which were taken down there by motor transport. "There is the closest co-operation between the British and French, and, recently, General Haig loaned to General Joffre 400 Lewis machine guns which are being used in the French advance trenches at Verdun." These weapons, weighing only twenty five pounds without the tripod, can be carried on a man's shoulders, and the moment that the enemy's artillery fire ceases, a sandbag, rock, or any projecting mound of earth on the lip of the shell craters, or upon what is left of the trenches, serves as a rest.

Speaking of the possibility of the recovery of Belgium he stated that, a year ago, the English could have accomplished much if their whole force had been thrown into Belgium at that time. Since then the Germans have built a network of military railways parallel to their front and connecting with the main Belgian railways, by means of which they can make such a swift concentration of troops as to render the problem of breaking through so costly in men as to discourage any such attempt.

It is the opinion of this observer that the final collapse of the Central Powers will be brought about, not by a shortage of food, munitions or money, but by the ultimate and inevitable shortage of men. At present, taking all theaters of the European war, they have to maintain some 2,000 miles of front. The loss of men in the never-ceasing smaller actions incidental to trench warfare, and in great undertakings such as the attack on Verdun and the Russian offensive against the Austrian line, reaches an enormous figure, and two years from now, when the vast Russian hordes, fully drilled and equipped, move forward, it is believed that the final and decisive phase of the great war will have been reached.

As an offset to her gradual decrease in effectives, Germany is steadily growing stronger in munitions. "Germany is accomplishing with materials what she could never have accomplished with men." Take the case of the machine-gun equipment. At the start Germany had 50,000 of these, to-day, in spite of large losses, her equipment is believed to stand at 75,000. It is her plan to provide one machine gun to each twenty men on the front line. The Allies are making desperate efforts to match this equipment, both Great Britain and France have now, or soon will have, 32 machine guns per 1,000 men, which works out to about two thirds of the German equipment. Russia is far behind this ratio, but is gradually picking up.

"Italy," says our informant, "is the great disappointment of the war. She never contemplated such a fight with Austria as that in which she is now engaged. She thought she could hold the mountain passes against the remnants of the Austrian army. She is poorly munitioned and financed, and the reported extensive equipment of heavy artillery is largely a myth."

As to Russia, which this high military authority believes will be the ultimate decisive factor in the war, the present conditions are that she has 9,000,000 of men with the colors undergoing intensive training, and, of these, 5,000,000 are equipped more or less indifferently. The work of equipping the Russians is being carried out by her own factories and by those of France, Great Britain, the United States and Japan, and it is estimated that within two years' time the 9,000,000 troops of Russia will be in a condition to move forward for a decisive blow.

What is "Sleet"?

THE United States Weather Bureau has addressed a circular letter to a number of prominent philologists and meteorologists, as well as to public utility companies and the editors of engineering journals, seeking their advice as to the way in which the term "sleet" should be used for official purposes, and requesting information concerning the current use or uses of the term in different parts of the country. The immediate reason for this inquiry is that the Bureau is contemplating an investigation of the causes and the prevalence of ice deposits on telegraph, telephone and electric transmission wires, a phenomenom to which the expression "sleet" is now very commonly applied in this country.

The Bureau states that a search of dictionaries and of a large amount of technical and non technical literature reveals the following facts:

(1) In England "sleet" means usually, though not invariably, a mixture of raindrops and snowflakes.

(2) In the United States the term "sleet" has nearly always been applied by meteorologists to some form of water (other than snow) that is in a frozen state before reaching the ground, viz., either small particles of clear ice (often mingled with rain or snow), or little snow like pellets, differing from true hailstones, but often called "winter hail" or "soft hail." (The latter form of precipitation is called *Graupel* in German, and, under the influence of German writings, American and English meteorologists have used this word to some extent. The French equivalent is *grésil*.)

(3) Non meteorological usage in this country varies. The uses noted above under (1) and (2) are more or less common, but there is also another, in accordance with which the term "sleet" is applied to a coating of ice, formed on terrestrial objects by rain which freezes after contact with such objects. In England such an ice coating is usually called "glazed frost," and this term has been adopted for official purposes by the British Meteorological Office. Another name for such a deposit is "silver thaw." This curious expression has been known in both Great Britain and America for a very long time. It occurs in Cartwright's Journal (1792) with reference to the prevalence of the phenomenon in Labrador. Last, but not least, when the deposit is heavy, and especially when it results in the breaking of branches, wires, etc., the phenomenon as a whole is very commonly called, in this country, an "ice storm."

On referring to the dictionaries we find very little authority for applying the name "sleet" to a sheet of ice produced by falling rain, yet the term is almost universally used in this way nowadays by American electrical companies and railways, in connection with troublesome deposits on wires, cross-arms, and rails. On the other hand, the public at large has by no means abandoned the earlier—and, one might say, more orthodox—uses of the term. The Weather Bureau itself has generally identified sleet with frozen raindrops.

In short, several quite distinct forms of precipitation have gone under the name of "sleet," and it is highly desirable that these should be clearly differentiated in the scientific vocabulary.

The Coming Age of Research

THERE are two ways of looking at the cataclysmal events in which Europe—and incidentally the rest of the world—has lately been involved. Viewing only the dark side of the picture, one beholds an incalculable waste of human life and welfare, and a repudiation of the guarantees of Christianity and civilization boding ill for the future of our race. Fortunately, however, the picture has another side. The tragedy of the great war is so [illegible] so appalling that one who should [illegible] terize it as "a blessing in disguise" would [illegible] taxed with heartless flippancy; yet that many blessings have already sprung from it, as by-products, while others, still nascent, promise splendid development upon the restoration of peace, must be evident even to the most pessimistic observer.

This is not the place to forecast the social and moral consequences of the war. We should like, however, to dwell for a moment upon the hopeful outlook which science now enjoys, notwithstanding the misfortunes which it has, in common with other human activities, suffered in the general débâcle. That which science has especially gained from the war is prestige. Neglect of science in certain quarters has brought such retribution to the negligent ones that the lesson will probably never need to be repeated. This is true not only of science as applicable to military purposes, but also of science as applicable to industry.

The war has given an impetus to scientific research, the material and intellectual fruits of which cannot yet be estimated. Is it too sanguine a hope that they may actually indemnify the world for all that the struggle has cost?

This impetus has manifested itself in two ways: first, in the increased attention which various manufacturers have been forced by recent circumstances to devote to the scientific side of their own industries; second, and especially, in the elaborate plans adopted by various governments for the promotion of research on a national scale. Thus, the British government, besides organizing research on behalf of the army and navy, has developed a scheme for an "advisory council on industrial research," which will control all government activities under this head.

This means, among other things, that the universities and other educational establishments will be encouraged by the government—if necessary by means of state subventions—to train even specifically for particular lines of research.

In Australia steps have been taken to form a new official body which is to be known as "the Commonwealth Institute of Science and Industry," and which will exercise much more extensive powers than those intrusted to the British organization, since its duties will not be merely advisory, but it will assume direct control of a vast amount of research and practical work in behalf of Australian industries.

In Japan a national laboratory for physical and chemical research has just been established. Other government undertakings of analogous character are reported to be in prospect in various foreign countries.

Lastly, in our own country an interesting scheme for scientific industrial research under government auspices has recently been evolved along lines differing considerably from those of the projects above mentioned. On March 9th Senator Newlands introduced a bill (S 4874), now in the hands of the Senate Committee on Agriculture and Forestry, which provides for establishing "experiment stations in engineering and in the other branches of the mechanic arts" in connection with the "land grant" colleges throughout the country. These stations are designed to do for industrial research what the agricultural experiment stations are doing for agricultural research. Under the terms of the bill, "it shall be the object and duty of said experiment stations to conduct original researches, to verify experiments, and to compile data in engineering and in the other branches of the mechanic arts as applied to the interests of the people of the United States, and particularly of such as are engaged in the industries; also to conduct researches, investigations and experiments in connection with the production, transportation, extraction and manufacture of substances utilized in the application of engineering and of other branches of the mechanic arts to industrial pursuits. Water supplies, as to potability and economic distribution; sewage purification, and its ultimate inoffensive disposal; economic disposal of urban and manufacturing wastes; flood protection; architecture; road building; are some of the items which fall within the field of this undertaking engineering problems connected with transportation, manufacturing and public utilities; and such other researches or experiments bearing directly on the various industries and occupations of the people of the United States as may in each case be deemed advisable."

To carry out this [illegible] programme the sum of $15,000 per annum is appropriated to each state and territory. The work of the stations is to be under the supervision of the Secretary of the Interior.

We shall probably have more to say on the subject of the Newlands bill at some future time. [illegible]

Are we not [illegible] research such as the world has never [illegible]

Electricity

Testing Illuminants with a Camera—An American company has recently been conducting a series of experiments on comparative illumination by means of photography. In each instance a photograph is taken by the light shed by the illuminant, and the plate developed for comparison with others. Obviously, the exposure in each instance is identical.

Electric Portable Saw Mills—It is reported that electrically operated mills of the portable type are rapidly gaining in favor among lumbermen. In localities where water power is abundant and has already been partially converted into cheap electric power the portable sawmill is especially popular. According to the president of a firm which is manufacturing electric portable sawmills, the demand is fast increasing in the South and West at the present time.

The Use of Zinc Wire in Germany is a subject of much discussion at present in the electrical periodicals of Germany, due to the increasing scarcity of copper and because iron wires are not always satisfactory. Considering the conductivity of copper to be 100 per cent, that of aluminum is 58.4, that of zinc is 28.5, while that of iron is 12.5. Rules are given on the use of zinc wires in house installations and on the use of zinc cables and zinc bus bars in the German periodicals devoted to the electrical trade.

Intensive Culture by Means of Electric Light—Lecturing before the Royal Institution of Great Britain, Prof. F. Keble recently stated that Germany, Italy and California were great seed growing countries on account of their high intensity of sunlight. Since experiments have demonstrated that the yield of crops may be increased materially by artificial light Prof. Keble suggests that perhaps in the distant future it will be possible to reinforce the obscure daylight that exists in England by the light secured from electric lamps.

Proposed Electrification of Canadian Railroad—According to a statement recently made by an official of the Canadian Pacific Railway, a plan of electrifying its lines through the mountains on the British Columbia division is now under consideration. Ability to haul heavier loads with greater speed on steep grades, the unimpaired efficiency despite intense cold and snow, and the economies effected in operating expenses are among the inducements offered by electrical operation over steam operation.

High Gasoline Cost and Electric Vehicles—Among other things the increasing cost of gasoline is rapidly popularizing the electric vehicle to a degree never before attained. According to the Electric Vehicle Association the average cost of electricity per mile for a 5-ton unit has been found to be as low as 4 1/10 cents. Consequently an electric truck on this basis operating 35 miles per day would cost \$1.43 and for 50 miles per day \$2.05 for current. And it should be remembered that in the case of the electric vehicle, in marked contradistinction to the gasoline vehicle, the greater the number of units in operation the lower will be the cost of motive power. In recent years electric current has been steadily diminishing in cost.

Electric Pocket Lamps in Verdun Fighting—Attention has been called before in these columns to the wide employment of electric pocket lamps in the present war. According to a special correspondent of the New York *Times* electric pocket lamps have played an important rôle in at least one engagement around Verdun, namely, the retaking of the Haudromont quarries by the French, of which he says in part: "Under ground in the quarries the darkness was absolute save when bursting grenades showed brief visions of carnage and terror. Friend often grappled friend, until the French adopted the plan of fastening an electric pocket lamp to the tunic button. The light gave the Germans a better mark, but enabled the French to rally together and sweep the foe back in the final rush en masse."

Electrified Oat and Potato Crops—According to the *Electrical Review*, a Miss Dudgeon of Dumfries, Scotland, has for some years conducted important experiments and observed the effects of electricity upon the growth of potato and oat crops. Most satisfactory results were experienced with the potato crops in three successive years, the increased yield per acre with electricity being 1,204 pounds in 1912, 1,456 pounds in 1913, and 2,576 pounds in 1914. In oats the difference was most conspicuous right from the beginning of the experiment, and the electrically treated crops suffered less than others from the drought which prevailed. The difference amounted to 31 per cent in grain and 31 per cent in straw in favor of electricity. The Dumfries experiments prove that under the influence of the electric discharge the ingredients in the soil are more soluble and more easy of assimilation; that by the aid of electric current sap is enabled to flow more vigorously and the formation of sugar and starch is increased; also that respiration, absorption and evaporation are accelerated.

Science

German Geographical Studies in Poland.—The German provisional government in Russian Poland has established, with headquarters at Warsaw, a "geographical commission" which will undertake elaborate investigations of all branches of Polish geography, including geology, climatology, ethnography, etc. Prof. Dr. Max Friederichsen, of the University of Griefswald, has been appointed scientific director. The commission proposes to publish a geographical handbook of Poland, and also a series of memoirs on special topics under the title "Beiträge zur Landeskunde von Polen."

Aeroplane Mail Service—Bids were opened on May 13th at the Post Office Department in Washington for aeroplane mail service on seven routes in Alaska and one in Massachusetts with the disappointing result that the only bid received was for service between Seward and Iditarod, Alaska, a distance of 380 miles, at \$45,500 a year. This route with overland transportation now costs the Government \$22,865 a year, but other routes where it is proposed to try aeroplane service cost as much as \$100,000. The proposed aeroplane route in Massachusetts is from New Bedford to Nantucket. The lack of bidders is ascribed to the fact that aeroplane manufacturers are busy with war orders.

The Nutritive Value of Highly Milled Flour—The U. S. Public Health Service has stirred up a hornets' nest among the milling interests of the northwest by the publication of a paper by Messrs. Voegtlin, Sullivan and Myers, which, under the innocent title of "Bread as Food," severely arraigns the dietary character of the highly milled corn and wheat flours now commonly used in this country. It is claimed that the vitamines (which now figure so conspicuously in the literature of dietetics) of the grains in question are chiefly located in the bran and germ, which are largely eliminated by the modern roller process of milling, and deficiency in vitamines leads to the prevalence of such diseases as pellagra and beriberi. The Northwestern Millers' Association has protested against the publication of the paper above mentioned (which is a preliminary announcement of data to be published in a bulletin of the Hygienic Laboratory), declaring that the conclusions of its authors are unwarranted by the facts.

The Araroba or Goa Powder of Brazil forms the subject of an interesting report from Consul Robert Frazer, Jr., stationed at Bahia. The world's supply of this powder is said to come entirely from the State of Bahia. From it is obtained the substance known as chrysarobin, used in the treatment of skin diseases, especially psoriasis. The trees from which this product is obtained grow wild and are known locally as *amargoso do matto*. The substance is found in the form of a pulp or small solid masses in crevices of the heart wood, and is said to be a morbid growth. The trees are felled and split open and the damp lumps of araroba are removed, dried and finally powdered. It is of a bright yellow color when extracted, but turns to various shades of yellowish brown. In some cases a single tree yields as much as 60 to 65 pounds. A very caustic liquid is found in the tree in connection with this substance. Both the araroba powder and this liquid are very dangerous to handle. Mr. Frazer states that "those engaged in the work for any length of time although protected by gloves and masks with glass eyepieces invariably lose their hair, eyebrows and eyelashes, and sometimes even become blind." The powder is packed for transportation in hermetically sealed tins enclosed in wooden cases.

Precautions Against the Introduction of Plant Diseases.—A recent paper by Mr. G. R. Lyman describes the difficulties with which the Federal Horticultural Board has to deal in the inspection of plant material imported by the U. S. Department of Agriculture for experimental and introduction purposes. Commercial importations do not, as a rule, present any serious difficulty, as the variety of host plants involved is not great and the importations are usually from countries where the diseases are well known. The importations of the Department, on the other hand, come from every part of the world, and the variety of host plants is almost unlimited. Both host and disease may be new and hence potentially dangerous. There is a specially constructed inspection house in Washington where all such importations are received, and the packages are opened in the presence of the inspectors, all wrappings being burned. After a rigorous examination the material is passed, if apparently clean, burned if dangerous diseases are found, ordered fumigated, where pests can be thus eradicated, or, lastly, ordered grown in quarantine. There is a special quarantine greenhouse, adjoining the inspection house, where suspicious plants may be isolated and all plants are grown under close observation.

Automobile Notes

A Practical Speed Indicator—It is stated that in some places in England motorbus companies are compelled to fit their vehicles with a hooter that automatically gives warning when a speed of twelve miles an hour is exceeded.

Automobiles and Game Destruction—Evidence is accumulating, especially from the western states, that the automobile has become an important factor in the extermination of game of all kinds, as its speed and ground covering abilities enable sportsmen to make hunting expeditions more frequently, and moreover, many motor owners who ordinarily take no interest in sporting, have taken to game killing as a new and, to them, novel use of the machine, all of which is hastening the exit of our rapidly disappearing wild animals and birds. It is also claimed that the automobile is being widely utilized to enable their owners to violate the game laws and evade the game wardens.

A Good Roads Photographic Contest—The National Highways Association announces a prize contest for photographs that can be used for demonstrating the needs and advantages of good roads. The contest is open to everyone whether a member of the association or not, and any number of pictures can be submitted. The photographs must be of some road within the United States, and may show good or bad roads, as long as they tell a story. Cash prizes to the amount of \$2,000 are offered, ranging from \$500 to \$5, there being 166 prizes in all. The contest is open until November 7th and particulars can be obtained by addressing "Good Roads Everywhere Photograph Contest," National Highways Association, Washington, D. C.

Lubricating Gear Boxes—Speaking of gear box lubrication, *The Auto* says, "The majority of modern cars have their gear box designed to retain oil as a lubricant, which for this purpose is preferable to grease. In regard to quantity some experiments conducted at the National Physical Laboratory showed that this had a considerable effect on the efficiency. Running on top gear a certain car gave the following results: With the gear box full of oil 74 per cent of the power delivered to the gear box was transmitted to the propeller shaft, 90 per cent when three quarters full, 94 per cent one half full, and 97.5 per cent when one quarter full." Of course if the supply of lubricant is kept as low as indicated here it would be necessary to make renewals frequently and systematically.

The Popular Light Car—Although the cyclecar was a fizzle as was anticipated by everyone acquainted with motor mechanics and road conditions, there is an undoubted demand for a small car that is reasonably light in weight and moderate in power, combined with as complete simplicity as is compatible with convenience and efficiency. The people who want such a car are not merely those who cannot afford anything larger, but there are many owners of big high powered cars who realize that it is not reasonable to wear out a big car that is costly to buy and expensive to operate on trivial errands that can be much better and more conveniently done with the smaller machine, and this demand will increase as people get over the habit of buying a new car every year.

Is the Chamois Dangerous?—A number of statements have been published to the effect that the pouring of gasoline through a chamois skin in a funnel will generate enough electricity to ignite the gases unless the funnel is grounded on the tank. This is contradicted by Professor Foley of the Indiana University. He says, however, that when the atmosphere is very dry, as it usually is on a cold, clear day, a man may become charged by scuffling about on a clean dry floor, or his clothing may become electrified by friction, as noticed sometimes when combing the hair. Under such circumstances pouring gasoline through a funnel, whether or not there is any chamois in it, gives rise to induced charges that are quite too complicated to undertake to explain in a few words. Such charges might fire the gas.

Thermo-Syphon Cooling—An advantage claimed for the thermo-syphon system of cooling in cold weather is that the cylinders are brought to a correct operating temperature very quickly, as the circulation of the water through the radiator does not begin until the water in the cylinder jacket becomes sufficiently hot. The quantity of water in the jacket is quite small, and consequently but a short time is required to warm this up to a working temperature, after which the circulation proceeds so gradually that the cylinder temperature is not affected by the passage of the remaining water in the circulation system. The pump, on the other hand, begins to circulate the water as soon as the engine is turned over, and consequently the cylinders do not reach their best operating temperature until all of the cooling water in the system has been heated.

Dr. Cook photo

A view of Banco Land in the Strait discovered by the Belgian Antarctic Expedition

Shackleton's South Polar Expedition

The Value of His Scientific Observations

By Henryk Arctowski

IN February 1914, Sir Ernest Shackleton laid down before the Royal Geographical Society of London his programme of a new Antarctic expedition. The purpose of this expedition may best be appreciated from Shackleton's own statement. He wrote: "My object is to cross the South Polar Continent from sea to sea—from the Weddell Sea to the Ross Sea. The crossing of the South Polar Continent will be the biggest Polar journey ever yet attempted. From a geographical point of view the complete continental nature of the Antarctic can be absolutely solved by such a journey. The geological results will be of the greatest interest to the scientific world. The expedition will take continuous magnetic observations from the Weddell Sea right across the Pole. All branches of science will be most carefully attended to, and the net result scientifically ought to be a large increase to human knowledge but, first and foremost, the crossing of the Polar Continent will be the main object of the expedition."

This bold project of a trans-Antarctic expedition was most favorably received, and apparently without great difficulties Shackleton secured the necessary funds for the realization of his project.

He left Buenos Aires on board the "Endurance" on October 26, 1914, and in February, 1915, the last word was heard from him.

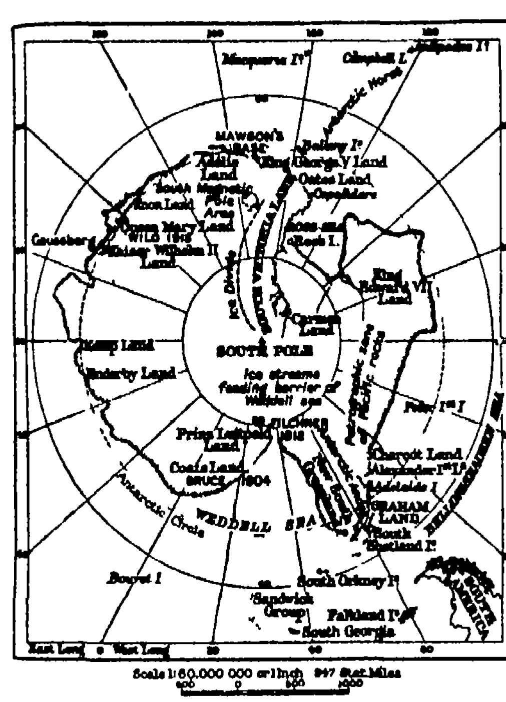
As we all know from the cablegrams that reached New York on June 1 and 2, Sir Ernest Shackleton met most adverse ice conditions in the Weddell Sea, and although he succeeded in discovering new land, he was prevented from accomplishing the object of his expedition.

No attempt at a trans-Antarctic journey could be made. The 'Endurance' was beset in the pack in January, and from then on the ice-fields remained closed and the ship was adrift. Shackleton speaks of strong gales and then of the normal "blizzards during the winter." The "Endurance drifted southwest reaching a farthest south of 77° in long. 35° W. Then the zigzag drift across Weddell Sea continued northwest. In June and July intense ice pressure was experienced. In August and September the Endurance" was the focus of active pressure and in October the ship was finally crushed by the ice, and sank on November 20.

Much credit is due to Shackleton for having brought back his men across the ice and sea to the South Shetlands and for having successfully reached South Georgia in a boat journey.

Evidently a relief expedition will promptly be sent from the Falkland Islands or Argentina to rescue the main party, left on Elephant Island and it is to be hoped that succor will reach these gallant men in time to prevent more suffering.

I think that probably none of the so numerous Polar expeditions has been more successfully conducted, and at the same time I may venture to say that in the history of Antarctic exploration it would be difficult to find another example of an expedition having accomplished so little of the programme originally set forth.



Professor David's sketch map of the Antarctic continent

It seems evident that Shackleton counted too much on good luck and did not sufficiently take into consideration the possibility of adverse ice conditions.

Personally, I think however, that Shackleton's programme was not wrong and that he could have succeeded if the year selected for his enterprise would have been the right year. In other words, I suppose that there are years, perhaps only exceptional years, when Weddell Sea is navigable to its most southern latitudes during the summer months, but that probably more frequently it is practically entirely covered with heavy pack ice. Moreover I would say that the study of these changes of the ice conditions of Weddell Sea may be of great scientific importance, and that the meteorological and oceanographical observations made by Shackleton's expedition will probably be of greater value than the observations that Shackleton would have made in a journey across the Antarctic continent.

I have to explain this statement. The prevailing winds observed near the Gaussberg by the German Antarctic expedition of von Drygalski have been easterly or anticyclonic winds. On board of the "Belgica," southwest of Graham Land, I observed in 1898 and 1899 a well pronounced annual variation of the wind roses. During the winter months west and southwest winds predominated, while during the summer winds from the northeast and east were most frequent. It follows that while the continental anticyclonic winds, also observed by Mawson on Wilkes Land, extend south of Africa, all the year round, as far and even farther north than the Polar Circle, in the southwest of Graham Land, on the contrary, such winds predominate only during the summer, while during the winter the sub-Antarctic cyclones travel further south, so that all wind directions may be observed. In other words, the Antarctic barometric high pressure area shifts periodically, and in the Weddell Sea, where all the ice drifting with the winds from the east towards the west is accumulated, the ice conditions must be greatly influenced by the changes of the intensity and extent of the Antarctic anticyclone that may occur from season to season or from year to year.

But with the course of years the general distribution of the atmospheric pressure may vary slightly. Such changes have been observed and studied by Hildebrandsson, by Lockyer and others. I myself have devoted much time to the study of the North American data. It follows from all these researches that the variations from normal conditions observed in one region of the globe are influenced and influence the variations observed simultaneously, or later on, in other regions. It follows that in the course of the years the center of the Antarctic anticyclone must change its position, and that for

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Arctowski photo.

Cape Renard, a typical mountain of the Antarctic Andes

Comparative Zeppelin strength of Germany, France and Great Britain at the outbreak of the war. On the left, thirteen German ships in commission and four (in white) building; on the right, above, one French ship built and two building, on the right, below, two British ships building

Mastery of the Air vs. Control of the Sea

Zeppelins as Observation Towers for the German Fleet

By Baron Ladislas d'Orcy, Member, American Institute of Aeronautical Engineers

THE following article was written three weeks ago Since then the great battle off the coast of Jutland has been fought The advantage possessed by the German fleet in the early hours of the engagement bears out the author's contention that Great Britain's near sighted navy though master of the sea, is badly handicapped by Germany's mastery of the air above the sea, which gives the German fleet an eighty mile radius of vision —EDITOR

THERE is such a thing as *air power*. When a squadron of German Zeppelins* is capable of crossing the 400 odd nautical miles which separate Germany's North Sea coast from English shores, when it can discharge two tons of shells per vessel, ward off British fighting aeroplanes and safely return to port without being seriously interfered with—which is mostly the case—then that airship squadron indubitably proves the existence of air power

Sea power is chiefly a matter of construction, training and numbers, so is air power Only a fleet comprising vessels of all types in due proportion can effectively exercise sea power, the same rule applies to air power To rely only upon aeroplanes and anti aircraft guns for fighting Zeppelins is just as contrary to sound military science as it would be to intrust the defense of a maritime country entirely to coast batteries and mosquito craft.

To be sure, air power does not yet impose itself with an overwhelming a force as sea power, but this is due only to circumstances, as aircraft, being still in the initial stage of their development, cannot yet fully exercise the functions for which they are ultimately intended Some future day air power will surely dispute sea power and finally become supreme, and there are already indications at hand where air power is beginning to overlap on sea power

By opposing faster and heavier-gunned battle cruisers and a larger number of dreadnaughts to those of Germany, Great Britain has paralyzed German shipping and has bottled up the Kaiser's High Sea Fleet in the Kiel Canal she thus rules the seas. Still an inferior German battle cruiser squadron succeeded several times in raiding English coast towns, escaping—save once—without being intercepted and forced to fight Why? Simply because while England rules the seas, Germany rules the air above the seas, or more correctly speaking the air above the North Sea.

Great Britain has no Zeppelins, i. e., rigid airships capable of great endurance, for reconnoitering the North Sea, and as seaplanes do not possess a radius of action sufficient to carry out this duty Sir John Jellicoe's Grand Fleet has to rely on its 30-knot scout cruisers whose range of vision is limited to 20 miles, for gathering information about the enemy's whereabouts Observation balloons and kites offer but poor substitutes for long range airships, whose speed and movements are independent from naval vessels whereas balloons and kites are anchored to their mother ship and therefore are largely dependent on the latter's speed

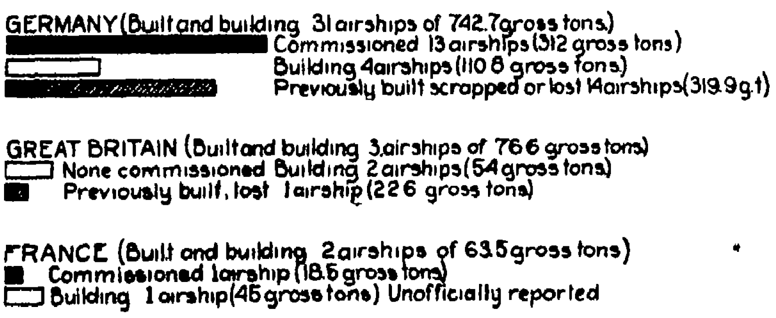


Table showing comparative strength of the Zeppelin fleets of Germany, Great Britain and France on August 1st, 1914

Now turning to the German "system" we find that a fleet escorted by Zeppelins, flying at a height of 5,000 feet and at a speed of about 60 knots, can detect the enemy at a distance of 80 miles, i. e., at a range four times greater than the one possessed by British naval scouts. The enormous tactical advantage gained thereby for the Germans has well been illustrated by the latest naval raid on Lowestoft, where, owing to their scout airships, the Germans were able to keep at a safe margin from the British battle cruiser squadron's ever watchful "eyes"

Such is the influence of air power upon sea power This extraordinary situation where a fleet gun for gun and ship for ship the superior of its foe, cannot prevent the latter—for lack of swift information—from raiding the shores of the country which is top dog on the sea, makes it worth while to examine the underlying causes which brought about this condition

For the past ten years the great military nations of Europe were all engaged in building up airship fleets, but it seems in the light of subsequent events, that Germany alone realized from the beginning the exact nature of the advantages a persistently followed up airship policy would confer upon her military and naval forces The nations now forming the Grand Alliance seemed chiefly concerned with the development of the aeroplane, convinced as they were that a fleet of such mosquito craft would quickly be able to put out of action any "gasbag," as airships were contemptuously referred to by their detractors

Still, for some time it looked as if France and, to some extent, Italy too, were determined to meet Germany's steadily growing airship fleet in the only way that might have put them on equal footing with the aerial forces flying the black crossed ensign by matching airship with airship But if such was their object both Latin countries were badly handicapped in this realization by a policy of misplaced patriotism which favored the building of non rigid and semi rigid airships exclusively these types being national products while it barred vessels of the rigid type for the sole reason that the latter had been originated in Germany

The Germans had no such scruples While Count Zeppelin was exerting every effort to improve his airships, the German army authorities tried to purchase in France one airship each of the semi rigid Lebaudy and the non rigid Astra types. Having failed to achieve their object the Germans resolved to copy the vessels they could not buy this is how the Gross Basenach and Parseval airships came into being It is but fair to add that, since this "inspired" inception vessels of the above named types have largely developed upon original lines.

(*Concluded on page 645*)

* Throughout this article the term *Zeppelin* is used in a generic sense, i. e., meaning a rigid airship, just as the term dreadnought is employed for describing an all big-gun ship

Strategic Moves of the War, June 9th, 1916

By Our Military Expert

FOR almost the first time in the course of the European war, the inauguration of a Russian offensive movement in force, attended by some measure of success, has been accompanied by a closely veiled censorship. The bare news is vouchsafed, at the moment these lines are written that the fortress of Lutsk, the western apex of the Volhynia triangle of fortress towns has fallen to the Russian advance which previous reports indicate as extending from the marshes of Pripet to the Bessarabian frontier, over a distance exceeding 250 miles.

Petrograd claims the capture of about 55 000 Austrian troops so far in the movement. As the Austrian strength which is currently reported to be holding the section of the line under assault seems to be about 600,000, this capture represents about one eleventh of the entire strength no inconsiderable proportion when the casualty probabilities are also taken into consideration.

The reported fall of Lutsk seems strange when its position is compared with that of the Dubno fortress. According to information which has remained unchanged for months, the Russian line was between 25 and 30 miles east of Lutsk, while at Dubno it inclosed the city on two almost three sides—yet there is no mention of the evacuation of Dubno. This city is on the direct line from the key fortress of Rovno which has remained in Russian hands, to Lemberg. If a general advance has been attended with success as claimed, it would be important and interesting to know the situation with regard to Dubno. Perhaps strategy indicated an easier way to secure its evacuation than at a great blood-cost for the occupation of Lutsk establishes a very real threat to the communications of the more southern fortress, and further Russian success will undoubtedly force an Austrian retirement.

The line of advance upon Lutsk is a most logical one, bearing rich promise of gain if successful. Lutsk lies at the head of a short branch line of railway which springs to the southward from the main line extending from Rovno to the important junction of Kovel which is a point of necessary gain before the junction of greater railway control at Brest Litovski can be attacked. The latter, as a junction is most necessary to Russian success on account of the radiation of roads on the west of which there are three, one leading northward to Grodno and Vilna, one west to the next junction at Lukov and a third and shorter line, highly valuable in a restricted advance, to Kholm, directly to the south. It is clear then that the primary objective is Kovel as a step toward Brest Litovski.

The topography of the land practically divides the Russian line from Riga to Roumania into two almost equal sections. (For map of region between Riga and the Roumanian border see SCIENTIFIC AMERICAN of April 8th, 1916, page 380.) In a general western direction from the district south of Pinsk, marsh lands lakes and streams form a broken chain to the Bug River, which is paralleled in the section by the north and south railway from Brest Litovski to Kholm as mentioned above. This chain of water barriers forms a comfortable rest for the right flank of the advancing Russian line one much more easily held than if it consisted of practicable terrain throughout its extent. And while an advance in strength is reasonably secured by this natural feature, it becomes more of a menace to its Teutonic defenders the farther westward the line extends for full possession of the country to the southward as far as the Bug would automatically require evacuation of the northern position held by the Germans unless the advance was repulsed. There has been more consistent activity in the neighborhood of the Styr and Tchartorysk on the part of the Russians for months than in any other sector, the reason is obvious—to secure the right flank against the day of general advance.

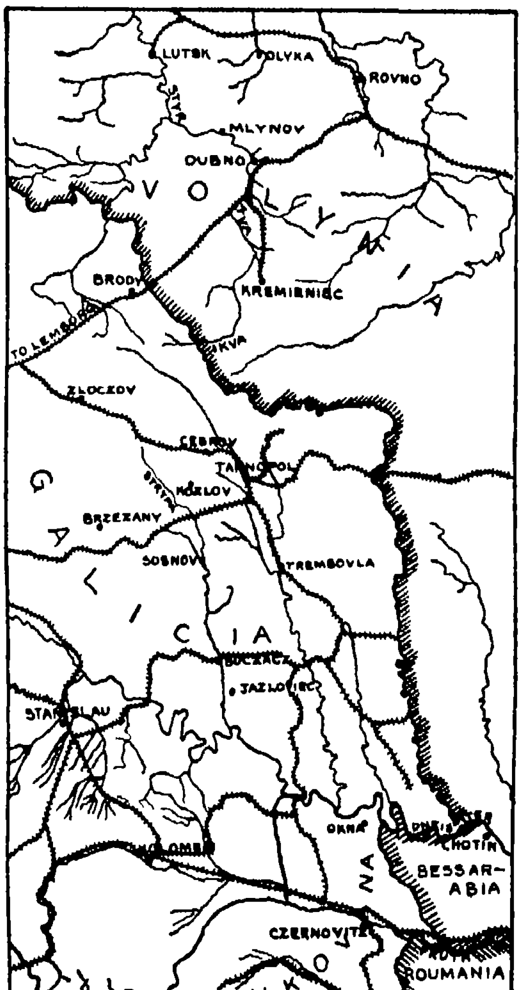
If this be the long expected Russian assumption of the offensive instead of a local activity—and it seems to be the former, for the strength of the attack combined with the length of the line appear to indicate it—it may mean either one of two things.

An immediate response to the Austrian attack upon Italy and an attempt to weaken the assaults which have continued for so long upon Verdun by forcing the detachment of troops to the eastward. In this case the offensive is a forced one and the bodies of troops engaged in it may or may not be thoroughly prepared in man power and munitions, or

It is definite indication that Russia has again surprised the world by being ready for major movements before she was expected to be—Russian mobilization in the first days of the war was complete long before even the German staff expected it.

After the long experience the Entente has had in this war, it is almost inconceivable that the high commands could repeat demonstration of their lack of concerted action and permit the most numerically powerful of their Allies to undertake major operations all alone—that is, without the active coöperation of other forces in other theaters of war. The dead Kitchener's army is available at last, so it is reported, the powerful forces at Saloniki seem ready for use, augmented by the lately arrived remnant of Serbia's army, some 100,000 strong. Will these armies let Russia go it alone? Or will some part of the great line in Flanders and France witness the attack of massed forces to prevent detachment of their opponents and their shifting eastward? And will the Macedonian frontier feel the tread of advancing hosts—for the same purpose, while Russia hurls her rejuvenated might upon the lines of Volhynia, Galicia and Bukovina?

With 800,000 Austrians massed against Italy and 600 000 on the Russian line a total of 1,400,000, Austria may possibly possess a reserve of from 400,000 to



Region between Lutsk and Czernovitz where the Russians have launched a drive

600 000 men, although the latter figure is considered improbable. Russia would scarcely undertake a general offensive of this magnitude with less than 5,000 men per mile of front, for the sector, a million and a quarter in all. To oppose this, unless Austria could detach strong forces from the Italian front even with throwing in her last reserves she could not muster over a million men to meet the attack, and that, at a late moment.

It scarcely seems possible that Germany could now give much material aid to her ally. Verdun has cost a very bitter price and the menace of the new British army becoming more of a disquieting specter with each passing day prohibits the material weakening of the northern half of the western line. The moment seems a most propitious one for the attempt to wrest the general initiative from the Kaiser's hands, for since the Marne and the great sweep of Russia through Galicia the Allies have never made any attempt to take the offensive except locally, Russia has gained by her stand at the Dvina time to rebuild her battered forces and arm and munition them properly with the vast reserve stores so necessary to a bitterly contested campaign, England has at least 3,000,000 available for action and 600,000 are situated on a strategic flank at Saloniki, ready to essay the clipping of Turkey from touch with her more powerful confederates of Europe.

The most interesting development to watch will be that of the dispositions by the Teutonic general staff to meet the newly made situation. Judging by past performances, the response of this brilliant body of soldiers should be startling by the effective correctness of it, even should fortune so favor the Entente as to compel Teutonic retirement to actual defense of the Empire. Many months ago the writer ventured the opinion that the real war would not begin until the Central Empires were compelled to take their turn on strict defense when the full benefit of concentrated interior lines would be had. And as nothing has since occurred to change the opinion, it is still adhered to. Perhaps its correctness may soon be demonstrated, perhaps not.

The Current Supplement

THOSE interested in the study of the heavenly bodies will welcome the article on *The Sidereal Center* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No 2111, for June 17th, which discusses some considerations tending to indicate that Canopus occupies this important position. In these days when so many amateur yachtsmen are building fast scout boats *A New System of Navigation and Nautical Astronomy* will be widely welcomed, as the method described is so simple as to relieve the abstruse science of navigation of many of its terrors to the uninitiated. The article is written by an acknowledged authority, and is fully illustrated by diagrams. While icy cold weather, accompanied by much snow, was experienced by the armies in France during the first year of the war, the past winter, although much milder in temperature, was marked by the almost continuous fall of rain that flooded the trenches and made living in them a matter of great discomfort. This condition is described in *Winter in the Trenches*, which is illustrated by several excellent pictures. *Electric Truck Troubles* tells of the experiences of the early truck builders, and how the difficulties were successfully overcome. *The Mechanism of a Dream* treats in an interesting way, of the operations of the mind when volition is in a state of suspension. *Chemical Gardens* illustrates and describes methods by which beautiful crystalline formations of various mineral silicates may be produced. These simple chemical experiments may be successfully performed by the younger members of the family. *Synchronous Gearing* explains some of the ingenious apparatus required for the successful operation of the printing telegraph, accompanied by illustrations and explanatory diagrams. Other valuable articles in this issue include *Artificial Seasoning of Timber*, *A Method of Drop Measuring Liquids and Suspensions* and *Energy of Transformation during Horizontal Walking*.

The Death of Charles Sooysmith

ON Friday, June 2nd, Charles Sooysmith died at his home on Riverside Drive, New York city, and the world lost one of its foremost civil engineers. He was in his sixty first year.

Mr Sooysmith was born in Buffalo, N Y, and studied civil engineering both in the Rensselaer Polytechnic Institute and in the Polytechnicum of Dresden and other European technical colleges. During 1879 1880 he was Assistant Superintendent of the Maintenance of Way Department of the Atchison, Topeka & Santa Fe Railroad, following which he founded an engineering firm, which undertook many important works. In the course of these he introduced the freezing method of excavation in this country and secured a number of patents for its use in subaqueous tunnels. He also used the caisson system for the first time. Mr Sooysmith was prominently identified in the construction of the New York subway, and for a time was a member of the Metropolitan Sewerage Commission. More recently he was connected with the building of the Belmont-McDonald rapid transit tunnel.

Nonslip Horseshoes Needed in Cuba

THERE should be a ready sale in Havana, Cuba, for a nonslip horseshoe. Most of the streets are paved with vitrified brick. They are as hard as iron, and the city's heavy traffic has worn them perfectly smooth, so that after a shower they are very slippery. Over 2,000 one-horse cabs are in use in Havana, and it is a common sight to see a horse flat on the ground from having slipped. At other times a horse will "skate" with his own momentum. There are also thousands of draft animals owned in the city, and the slippery streets prevent their pulling a full load, for shoes soon wear smooth and afford no purchase on the bricks. A nonslip horseshoe would fill a real need.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Rifle Sighting from an Engineer's Standpoint

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the subject, "How the rifle is sighted," and having read your able article of December 11, 1915, and the subsequent correspondence by crack shots, I desire to present the matter from an engineer's standpoint.

All engineer's sights used for exact work are based on the principle that they bisect the line of sight and the object sighted. Considering these sights in the order of their accuracy, the telescope stands first. In this instrument the line of sight passes through a focal point and is bisected vertically and horizontally by fine cross hairs, and when the instrument is trained on an object so that the cross hairs bisect the object vertically and horizontally then the telescope is in exact axial line.

The second class of sight is that of the surveyor's compass. In this instrument the first sight is a fine vertical slot in an upright bar on the near side of the compass, the second sight is a corresponding slot in an upright bar on the opposite side, and in the center of this latter slot is a fine vertical wire. The line of sight passes through these slots and is bisected by the wire in the second slot, and when this wire appears in the center of both slots and also cuts the object sighted the instrument is in accurate line.

The third class, peep hole sights, are used where only approximate accuracy is required and the distances sighted very short.

The fourth class, open sights common to the rifle, are not used on any engineer's instruments to my knowledge.

Assuming that the telescopic sight is objectionable for general use, there is no good reason why the principle of bisecting sights in a modified form should not be applied to the rifle. It would give speed and accuracy, and while the cost would be somewhat greater, this would be offset by saving of ammunition, and in military use it would be a saving of men.

ROBERT YATES.

Passaic, N. J.

The Scientific American in South America

To the Editor of the SCIENTIFIC AMERICAN:

Perhaps you will be interested in an experience I had at the local library this afternoon. I entered to consult several books of reference, and was astonished to see the SCIENTIFIC AMERICAN on the table where only the daily papers are kept. There was a man just finishing his reading of it, and three others quite evidently awaiting their turn. I engaged them in conversation, and found that one was an official of the railway, two were machinists and the fourth was a lawyer. The last told me that he looked forward anxiously to each arrival of the SCIENTIFIC AMERICAN because your articles on the strategy of the European war gave him more and clearer real news than all the daily papers.

On inquiring at the desk why the SCIENTIFIC AMERICAN is kept on the daily paper table I was informed that it is in such constant demand that it must be kept where it can be quickly reached. I have also found it on the tables of the most exclusive clubs of South America and much sought after by the members. It may seem a paradox but it certainly is a better export medium than many that are so-called.

F. C. DE VILLAVERDE.

Georgetown, Demerara, British Guiana.

The Giant Kew Pine

To the Editor of the SCIENTIFIC AMERICAN:

I was interested in reading Mr. John Beach's letter in your issue of January 15, 1916, identifying the Giant Kew pine with the variety known in Florida as the Smooth Cayenne. I doubt the latter could ever reach the proportions of a Giant Kew, given suitable climatic conditions, and although the two may be allied they may not be synonyms of the same variety. Still, I may be wrong.

The Giant Kew was first introduced from the Kew Gardens to Ceylon, where, I believe, it was grown at the Botanical Gardens, Peradeniya. The variety did not appeal to the people especially, as the plant required some amount of cultivation and attention, and, if grown at all, it was only in small patches. Later, when the plant was distributed farther East, the innate industry of the Chinese quickly brought it to the fore, and large quantities are annually grown (especially in Sarawak) both for local and outside consumption.

The natives here call the variety "Nanas Pound," but otherwise the recognized name is "Giant Kew," and even the R. B. Gardens of Peradeniya, to which I had the pleasure of supplying a few thousand suckers while in Ceylon, knew it by that name, and it is the only name under which Messrs. William Bros., of Henaratgoda, Ceylon, trade in.

If the variety is an exotic, it is more so out East than West, and as far as I am aware, this variety has no disease out here, but not a little damage is done to mature and ripe fruits by nocturnal rodents when grown in the vicinity of jungles and forests.

It is quite possible that Giant Kew fruits do not travel well, owing to the pericarp being softer and the fruit itself more juicy and luscious than any other variety, but for canning and dessert purposes there are few fruits that beat it.

W. L. VANDER SLOTT.

Department of Public Works and Surveys,
Kuching, Sarawak.

Is there Not Some Use for Chlorophyl?

To the Editor of the SCIENTIFIC AMERICAN:

It is noticed that everything that is of wide distribution, or that is very abundant in nature, is of great importance to the daily well being of mankind. It might be more conservative to say that almost everything, etc. As examples, iron, salt, oxygen, etc., may be mentioned. The use of all these antedates history.

I have often wondered why a substance so widely distributed as chlorophyl should not have been adapted to the uses of mankind. It would almost seem that Nature intended man to find a use for it, and was simply waiting until he "tumbled to it," to use an expression foreign to the dignified columns in which it will appear.

I have never heard of any extended use of chlorophyl nor of any investigations as to its adaptability. Has anything ever been done along this line?

ROBT. G. PILKINGTON.

Overhead Sprinkling for Truck Gardens

To the Editor of the SCIENTIFIC AMERICAN:

Your article on "Overhead Sprinkling for Truck Gardens" seems to imply that this form of applying water is quite novel in the East. Around St. Louis this has been in quite general use for the last three years, and possibly in an experimental way was tried out a year or two previously.

The truck farmers here usually utilize a wind mill to fill a tank from which they then distribute the water through galvanized iron pipes raised to the requisite distance from the ground on wood or galvanized iron supports. The orifices are usually simple holes drilled at proper angle into the pipes thus avoiding the expense of applying the small brass nozzles which your article speaks of.

The continued extension of the systems seems to imply that it has proved successful and economical, but of course it cannot compete with Texas, Louisiana and Florida for vegetables which are shipped in during January, February and at least a portion of March.

A. BLAIR RIDINGTON.

Feeding the Prisoners of War

By Our Berlin Correspondent

THE providing of adequate food to the prisoners of war raises a number of difficult problems, not only on account of the abnormal economical conditions created by the war but of the unprecedented numbers of prisoners interned in the concentration camps. The well being of these enormous masses belonging to all the enemy nations depends to a high degree on a continuance of a diet more or less in keeping with national customs, and, in the case of Orientals, on the observance of a stringent code of ritual laws.

In order to give due consideration to all these problems the German War Department, some time ago arranged for a course of lectures where the commissariat officers of German prisoner camps were initiated into the secrets of alimentary physiology and the art of cooking. Officers from 120 concentration camps attended these lectures, in connection with which an exposition was held.

Prof. Backhaus discussed the scientific principles of the feeding of prisoners, the various articles of food and the most suitable bills of fare; Dr. Rubens explained the rudiments of alimentary physiology; and Dr. Neumann dealt at some length with the question of bread supply. This problem is the more difficult as prisoners have to submit to the same limitations as the civil population, though some classes, the French and Russians in the first place, are used to a more abundant consumption of bread. In order to arrive, at least, at a partial solution of this problem, the War Department purchased large quantities of second rate rye and wheat meal, which in itself would not be suitable for baking, but which could be mixed with other kinds of meal not subject to government control. From this mixture, there was made, at the camp bakeries as well as by private firms, an additional bread which is kept for sale at the prisoners' canteens. By medical prescription, it is, however, supplied free to underfed prisoners, as well as to those doing hard work or who are otherwise difficult to feed.

The normal daily amounts of nutritive substances allowed for each prisoner are 85 grammes of albumen, 40 grammes of fat, 475 grammes of carbohydrates, with a total of 2700 calories (heat units). In the case of hard bodily work a surplus of 10 per cent is allowed.

The following sample of a bill of fare prepared by the War Department may be of interest: Coffee with 30 grammes of sugar, or preferably soup containing 100 grammes of solid substance is given in the morning. A soup consisting of 30 grammes of soya meal, 60 grammes of fecula and 10 grammes of fat has given especially satisfactory results. For the midday meal there should be provided 750 grammes of potatoes and 300 grammes of vegetables fresh or canned (or else, 40 grammes of dried vegetables). On three days in the week, this should be supplemented with meat (preferably twice fresh meat, and once salt meat), the prescribed amounts being 120 grammes with bones, or 100 grammes without bones. Another addition recommended by the War Department is 200 grammes of fish on two other days, and 150 grammes of pulse with at least 30 grammes of bacon fat or meat preserves on each of the remaining days. Salt, spices and fat should be supplied in abundance. A supper which has proved itself highly suitable is 600 to 750 grammes of potatoes in their skins, with 150 grammes of herring or 100 grammes of sausage or 100 grammes of cheese, the potatoes in their skins can be replaced by a "potato salad," dressed with oil, vinegar and sugar, and mixed with green salad. Thick soups, made from 100 to 150 grammes of beans or meal, are likewise excellent suppers. Rice with dried or stewed fruit is also quite suitable. Russian prisoners are, of course, afforded an opportunity to indulge in the drinking of tea, their national beverage. Wherever available, skimmed milk should be used freely. In choosing and preparing the food the special taste of each nation should be accounted for, as far as possible. This is not only humanitarian but the wisest course to follow, since a given amount of food is utilized to the best advantage and with the best results for the well being of prisoners if prepared in accordance with the men's own cooking methods. This is why native cooks are employed in many camps.

In the case of Orientals, there is the additional difficulty of accounting for religious customs. Mohammedans, like Jews, eat no pork, the pig being considered unclean, while Hindoos would not touch beef, oxen being to them holy animals. Moreover, both Mohammedans and Hindoos make a point of only eating meat prepared by their own coreligionists, from cattle slaughtered according to a special ritual.

The director of a German Commissariat Office, Mr. Schiel, lectured on the subject of food storage, dealing with the several methods of storing meat, and of store room ventilation. Löffler's mouse-typhus bacillus was recommended against the mouse nuisance. The different criteria on which the condition of preserves should be judged—rusting tins, gas production, etc.—were discussed at length.

Captain Storp spoke on the employment of war prisoners in the performance of productive work. He laid stress on the economical bearing of the problem, mainly from the point of view that enemy consumers should supply some equivalent for their maintenance. Work allowing of rapid results should be given the preference, harvest work and moor culture in the first place.

Other lectures dealt with the rôle of sugar, the food value of the soya bean, the meat and fish supply, adulteration and testing of food, canteen operation, etc. A specimen dinner was cooked every day at noon, and the afternoons were spent in discussing the lectures and visiting model plants.

An interesting adjunct to this course of lectures was an exposition where, beside a collection of plans of prisoners' encampments, specimens of prisoners' work were shown. A point has long been made in German military hospitals, of diverting the attention of patients from their ailments and the care for their future by ordering them to do all sorts of manual work, which has been found to exert a most beneficial effect on the healing process. A similar course has been followed at the concentration camps, and the results, as evidenced by the specimens shown at the exposition are gratifying as well as instructive. These exhibits in fact, allow not only the variable cleverness of the men, but the widely different mental disposition and abilities of the various nations, their customs and habits to be gauged. Wood paintings, carved work and water color paintings by French and Belgian prisoners, and drawings by Russians—mainly on war subjects—were on show. Interesting exhibits comprised carved wooden covers for prayer books, toys, tankards and vases made from clay, and forks and knives forged from nails. An artist had even constructed a violin.

The Great North Sea Battle

Tactics of the Engagement as Described by British Naval Officers

"**First phase, 3:45 P.M.**, May 31.—Beatty's battle cruisers, consisting of the 'Lion,' 'Princess Royal,' 'Queen Mary,' 'Tiger,' 'Inflexible,' 'Indomitable,' 'Invincible,' 'Indefatigable,' and 'New Zealand,' were on a southeasterly course followed at about two miles distance by the four 'Queen Elizabeths.'

"Enemy light cruisers were sighted and shortly afterwards the head of the German battle cruiser squadron consisting of the new cruiser 'Hindenburg,' the 'Seydlitz,' 'Derfflinger,' 'Lutzow,' 'Moltke' and possibly the 'Salamis.'

"Beatty at once began firing at a range of about 20,000 yards (12 miles), which shortened to 16,000 yards (9 miles) as the fleets closed. The Germans could see the British distinctly outlined against the light yellow sky. The Germans, covered by a haze, could be very indistinctly made out by our gunners.

"The 'Queen Elizabeths' opened fire one after another, as they came within range. The German battle cruisers turned to port and drew away to about 20,000 yards.

"**Second Stage, 4:40 P.M.**—A destroyer screen then appeared beyond the German battle cruisers. The whole German High Seas Fleet could be seen approaching on the northeastern horizon in three divisions coming to the support of their battle cruisers.

"The German battle cruisers now turned right round 16 points and took station in front of the battleships of the High Fleet.

Beatty's Quick Maneuver

"Beatty with his battle cruisers and supporting battleships, therefore, had before him the whole of the German battle fleet, and Jellicoe was still some distance away.

"The opposing fleets were now moving parallel to one another in opposite directions, and but for a master maneuver on the part of Beatty the British advance ships would have been cut off from Jellicoe's grand fleet. In order to avoid this and at the same time prepare the way so that Jellicoe might envelop his adversary Beatty immediately also turned right round 16 points so as to bring his ships parallel to the German battle cruisers and facing in the same direction.

"As soon as he was round he increased to full speed to get ahead of the Germans and take up a tactical position in advance of their line. He was able to do this, owing to the superior speed of our battle cruisers.

"Just before the turning point was reached, the 'Indefatigable' sank, probably from striking a mine, and the 'Queen Mary' and the 'Invincible' also were lost at the turning point, where of course the high seas fleet concentrated their fire.

"A little earlier as the German battle cruisers were turning the 'Queen Elizabeths' had in similar manner concentrated their fire on the turning point and destroyed a new German battle cruiser believed to be the Hindenburg.

"Beatty had now got round and headed away with the loss of three ships racing parallel to the German battle cruisers. The Queen Elizabeths' followed behind engaging the main High Seas Fleet.

Six Ships Attacked the Warspite

"**Third phase, 5 P.M.**—The 'Queen Elizabeths' now turned short to port 16 points in order to follow Beatty. The 'Warspite' jammed her steering gear, failed to get around, and drew the fire of six of the enemy, who closed in upon her.

"I am not surprised that the Germans claim her as a loss since on paper she ought to have been lost, but as a matter of fact though repeatedly straddled by shellfire with the water boiling up all around her she was not seriously hit and was able to sink one of her opponents. Her captain recovered control of the vessel, brought her around, and followed her consorts.

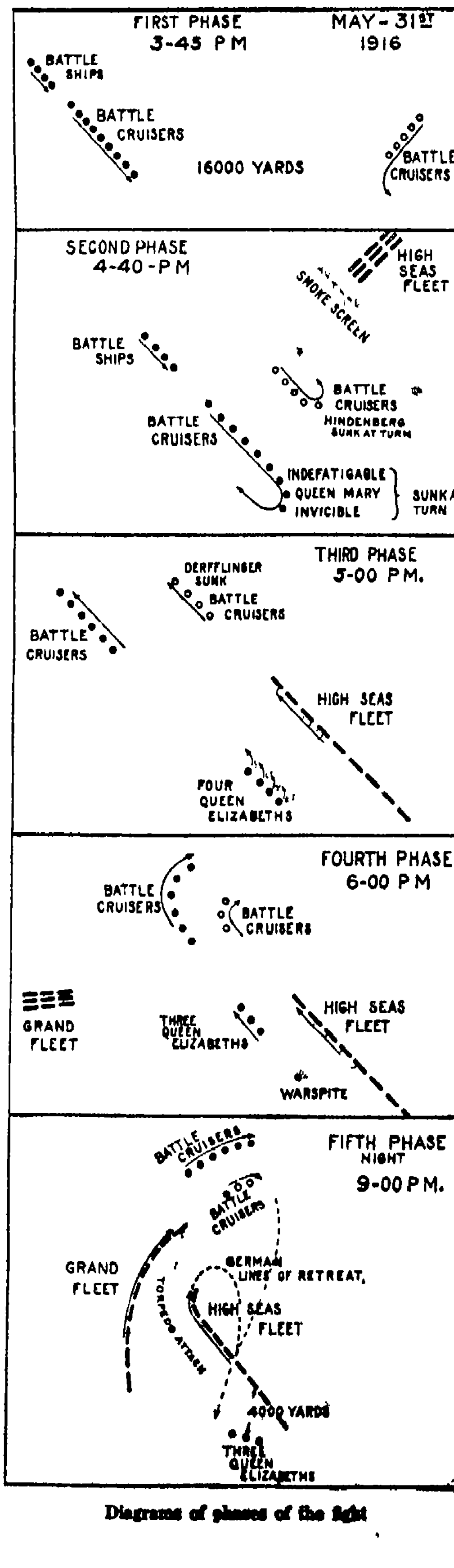
In the meantime the 'Barham,' 'Valiant' and 'Malaya' turned short so as to avoid the danger spot where the 'Queen Mary' and the 'Invincible' had been lost and for an hour until Jellicoe arrived fought a delaying action against the High Seas Fleet.

The Warspite joined them at about 5:15 o'clock and all four ships were so successfully maneuvered in order to upset the spotting corrections of their opponents that no hits of a seriously disabling character were suffered. They had the speed over their opponents by fully four knots, and were able to draw away from part of the long line of German battleships, which almost filled up the horizon.

"At this time the 'Queen Elizabeths' were steadily firing at the flashes of German guns at a range which varied between 12,000 and 15,000 yards, especially against those ships which were nearest them. The

[The only connected and understandable description of the Battle of the North Sea is that given by the Glasgow Herald and cabled in full to the New York Times of June 6th. It has all the earmarks of being written by one or more naval officers and it contains many intimate touches, which at once suggest an eyewitness possessed of thorough experience in the handling of ships and fleets. The fact that, if the maneuvers of the various phases of the battle are plotted out they piece together and form a logical sequence of events from the first gun to the escape of the German fleet by night through a gap in the British line and that the story agrees closely with the Admiralty reports, is strong evidence that in its main features, the description is substantially correct. We give the account verbatim. The diagrams, which have been drawn in this office, are based strictly upon the facts given in the article.

It should be understood that, in these diagrams, which illustrate the various phases of the engagement, the British ships are shown in full black and the German in outline. EDITOR.]



Diagrams of phases of the fight

Germans were enveloped in a mist and only smoke and flashes were visible.

"By 5:45 half of the High Seas Fleet had been left out of range, and the 'Queen Elizabeths' were steaming fast to join hands with Jellicoe.

"I must now return to Beatty's battle cruisers. They had succeeded in outflanking the German battle cruisers, which were, therefore, obliged to turn a full right angle to starboard to avoid being headed.

"Heavy fighting was renewed between the opposing battle cruiser squadrons, during which the 'Derfflinger' was sunk, but toward 6 o'clock the German fire slackened very considerably, showing that Beatty's battle cruisers and the 'Queen Elizabeths' had inflicted serious damage on their immediate opponents.

Jellicoe's Fleet Arrived

"**Fourth phase, 6 P.M.**—The Grand Fleet was now in sight and coming up fast in three directions (divisions?). The 'Queen Elizabeths' altered their course four points to the starboard and drew in toward the enemy to allow Jellicoe room to deploy into line.

"The Grand Fleet was perfectly maneuvered and the very difficult operation of deploying between the battle cruisers and the 'Queen Elizabeths' was perfectly timed.

"Jellicoe came up, fell in behind Beatty's cruisers, and, followed by the damaged but still serviceable 'Queen Elizabeths,' steamed right across the head of the German fleet.

"The first of the ships to come into action were the 'Revenge' and the 'Royal Oak' with their 15-inch guns, and the Agincourt which fired from her seven turrets with the speed almost of a Maxim gun.

"The whole British fleet had now became concentrated. They had been perfectly maneuvered, so as to 'cross the T' of the High Seas Fleet and, indeed, only decent light was necessary to complete their work of destroying the Germans in detail. The light did improve for a few minutes and the conditions were favorable to the British fleet, which was now in line approximately north and south across the head of the Germans.

"During the few minutes of good light Jellicoe smashed up the first three German ships, but the mist came down, visibility suddenly failed and the defeated High Seas Fleet was able to draw off in ragged divisions.

"**Fifth phase, night.**—The Germans were followed by the British who still had them enveloped between Jellicoe on the west, Beatty on the north, and Evan Thomas with his three 'Queen Elizabeths' on the south. The 'Warspite' had been sent back to her base.

"During the night our torpedo boat destroyers heavily attacked the German ships, and, although they lost seriously themselves, succeeded in sinking two of the enemy.

"Co-ordination of the units of the fleet was practically impossible to keep up, and the Germans discovered by the rays of their searchlights the three 'Queen Elizabeths' not more than 4,000 yards away. Unfortunately they were then able to escape between these battleships and Jellicoe, since we were not able to fire as our own destroyers were in the way.

"So ended the Jutland battle, which was fought as had been planned and was very nearly a great success. It was spoiled by the unfavorable weather conditions, especially at the critical moment, when the whole British fleet was concentrated and engaged in crushing the head of the German line.

"It was an action on our part of big guns, except, of course, for the destroyer work, since at a very early stage our big ships ceased to feel any anxiety from the German destroyers. The German small craft were rounded up by their British opponents and soon ceased to count as an organized body."

Anti-Aircraft Guns

MR. LANCHESTER, the well known English aeronautical expert, has examined the conditions under which aircraft can be successfully fired at from the ground. He states, and practice in the European war confirms his statement, that rifle and machine gun fire is out of the question for this purpose; for at a height of 7,000 feet the aeroplane can navigate in perfect safety and it would be difficult to hit it even a thousand feet lower.

"Not only would the velocity become so reduced as to render a hit capable of little mischief, but the time of flight of the bullet rising vertically to this altitude would be about eight or nine seconds, and the distance moved by the aeroplane 1,000 feet, more or less. Therefore it would be necessary to fire into quite a different part of the heavens from that in which the aero-

aeroplane was observed."

In order to overcome the deficiencies of the rifle bullet as far as aircraft are concerned (small range, low velocity and insufficient destructive power), several gun factories have produced so-called high-angle or anti aircraft guns, which are now extensively used by the European belligerents. These guns can fire almost vertically an explosive projectile weighing from 8 to 40 lbs. to a height of over 20,000 feet, they are usually mounted on armored motor cars so as to possess great mobility

In spite of this great mobility, it is nevertheless a case of mere luck if a single anti aircraft gun succeeds in winging an aeroplane It is therefore generally deemed necessary to have whole batteries of such guns fire at the same time if good results want to be attained.

Here are some data on foreign anti-aircraft guns, such as are now in use in the European war

The German Army is chiefly provided with a 71 millimeters (30 caliber) Krupp motor gun which carries six men and sixty two shells The car weighs, complete, 7 100 kg, the weight of the gun alone being 1,230 kg, the projectile weighs 5 kg and has a muzzle velocity of 650 meters. This gun can fire up to an elevation of 75 degrees the range being then 6,300 meters, the firing speed amounts to from 20 to 25 rounds per minute

This L-gun [so-called on account of the uncomfortable length of its official name (Luftfahrzeugabwehr kanone)] has a maximum speed of 60 kilometers per hour, it can climb a grade of 1 in 5 (20 per cent) and carries a 12 mm armor

The anti aircraft gun with which modern German submarines are equipped, being also a product of the Krupp factory, is very similar to the one just described Its bore is 88 mm and its barrel is 35 calibers long, it can fire from 20 to 25 projectiles per minute up to an elevation of 80 degrees, each projectile weighing 9 5 kg The muzzle velocity is 800 meters.

Krupp has produced a still more powerful anti air craft gun, which has a caliber of 105 mm and fires a shell weighing 15.5 kg with a muzzle velocity of 800 meters up to an elevation of 60 degrees. This shell discharges a smoke trail to facilitate aiming. The 105 mm L-gun is chiefly used for naval purposes and coast defense works, it is assumed on good authority that the new German dreadnoughts of the "Kronprinz" class and the scout cruisers of the "Wiesbaden" class each mount a number of these guns.

The Ehrhardt gun factory of Dusseldorf has also built a number of various anti-aircraft guns, all mounted on motor trucks whose caliber varies from 50 to 105 mm The most remarkable of these is the 35 caliber 65 mm anti air craft gun which fires a 4.1 kg projectile with an arc of elevation of 75 degrees and a muzzle velocity of 670 meters per second to a maximum height of 5 800 meters At an arc of elevation of 43 degrees the range attains 10 000 meters This gun can fire three sorts of projectiles (1) an ordinary shrapnel containing 150 steel balls of 9 grams each (2) a smoke shrapnel of 170 steel balls of the same weight, and (3) a "balloon grenade" which is particularly adapted for use against airships

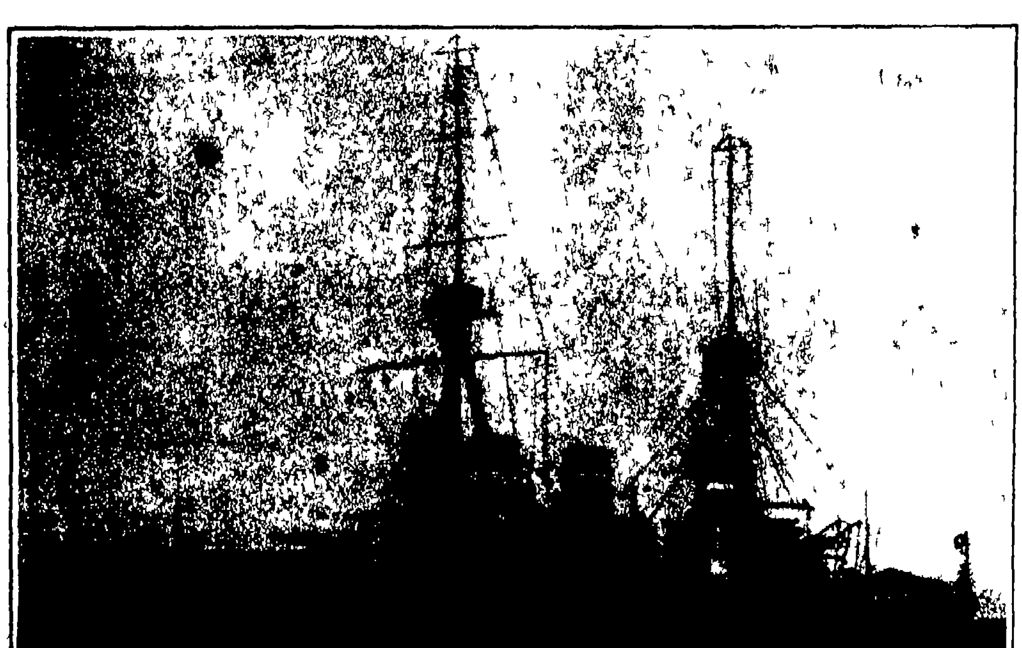
This gun is mounted on an armored motor car, which is protected by a 10 mm. steel plating on the top and the front part and by a 5 mm belt on the sides, it weighs complete 6,650 kg

The Skoda Gun Works of Pilzen (Austria) also supply an anti aircraft gun, which has a bore of 37 mm. (1 5 in) and is 70 calibers long This gun has a muzzle velocity of 1 000 meters per second and fires a projectile weighing 0 8 kg at an arc up to 80 degrees It weighs complete 615 kg and can be conveniently placed on any high powered motor car

Typical German battle-cruiser. Two of the latest of this type, the Hindenburg and Derfflinger, sunk

German dreadnought battleship Westfalen, twelve 11-inch guns, sunk. Also the predreadnought Pommern, four 11-inch guns

British battle-cruiser Queen Mary, eight 13.5-inch guns, sunk



British battle-cruiser Invincible, eight 12-inch guns, sunk; also the sister ship Indefatigable

CAPITAL SHIPS LOST ACCORDING TO ACCOMPANYING ACCOUNT OF THE BATTLE

Substitute for Gelatin Found in the Philippines

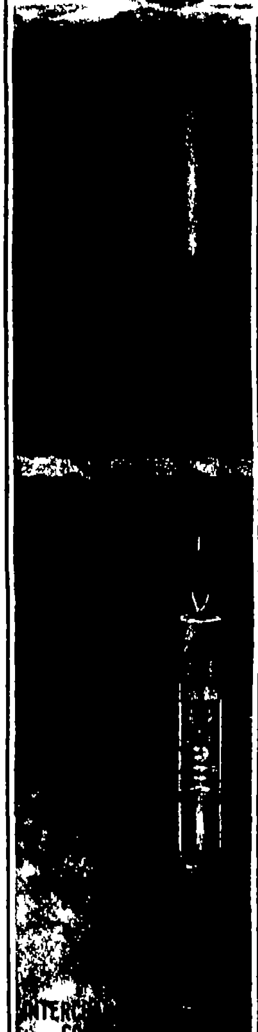
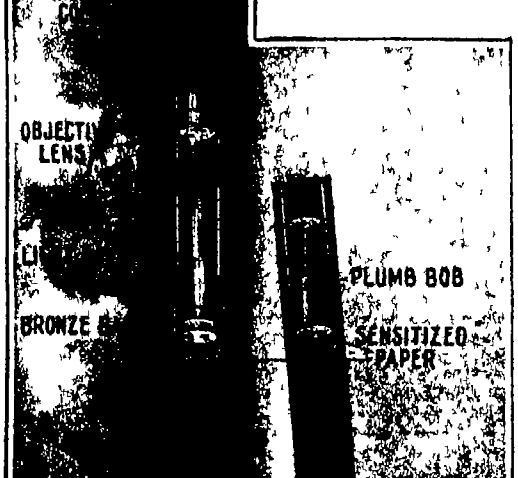
According to a recent issue of the *Commerce Reports*, a substitute for imported gelatin is made in the Philippines from a kind of seaweed brought in by the fishermen and sold in the markets. The native women use it to produce desserts similar to those made elsewhere from gelatin Foreigners also find it a good substitute for gelatin It is similar to the dried substances brought into the islands from Japan and China after being extracted from various kinds of seaweed by the Japanese and Chinese dried and marketed in the form of bundles

The preparation of gulaman, as it is known, is not carried on in the Philippines on a commercial scale, but the dried article is imported from Japan and China and is currently on sale at the small shops This commercial product is prepared by extracting the substance with boiling water, congealing the product, and then partially drying it before cutting into strips an eighth of an inch wide The strips are then thoroughly dried for shipment The yield is sometimes as much as 60 per cent One part of the substance to 300 parts of water yields a jelly on cooling

The amount of raw seaweed brought in now from the sea is not enough to meet the local demand for gelatin The cheapness of the imported article prevents a greater demand for the local substitute

A Novel Device for Making Deviation Tests or Surveys in Deep Drill Holes

IN diamond drill borings the drill deviates considerably from its starting direction, and because of this it is sometimes important to obtain a survey of the hole. There are several methods in use at the present time for making deviation tests. The one most generally employed consists in lowering into the boring a glass tube partly filled with a solution of hydro-fluoric acid and then measuring the angle between the axis of the tube and the plane of the etch line produced by the surface of the acid. Owing to capillarity refraction and the shortness of the etch line, however, accurate location and measurement of this angle is impossible; there is an error of from one to three degrees of arc. Moreover the etch line method gives no definite information concerning the lateral deviation or strike.

Drill hole surveying apparatus in position

In dry rock free from seams, so that a hydrostatic condition can be maintained in the hole when it is filled with water, a pressure gage arranged to record its maximum reading may be used to determine the water pressure in the hole at various intervals. These readings indicate the level at which they are taken, and the dip is then determined by considering this depth as one leg of a right triangle, and the depth along the hole as the hypothenuse. This method again does not indicate the strike.

The inventor of the device here illustrated, Charles B. Galvin, was employed on the test borings in connection with the Hudson River Tunnel of the new Catskill Aqueduct, and it was this experience that led him to devise an improved method for making drill hole surveys. In his device, an optical line of collimation, tangent to the curving axis of the hole, is formed by the projection of the image of a cross hair member, and the vertical and horizontal lines which intersect in the axis of the hole at the point for which the reading is taken are established by a gravity member—a plumb line or a rolling ball. The horizontal and vertical deviations are thereby indicated graphically and simultaneously, and recorded photographically on a disk of sensitized paper. The cross hairs consist of lines etched on clear glass, and are so designed that their center point may be plotted even if it falls off the disk. A source of light, which may be a one- or two-candle power battery lamp, current supplied from the surface via the cable, is situated in the focus of the condenser in the manner shown. An efficient illumination of the cross hair glass is thus obtained, and a

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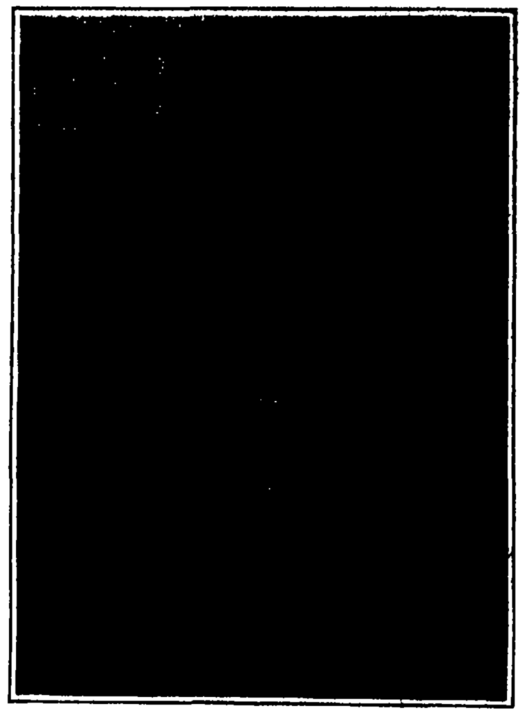
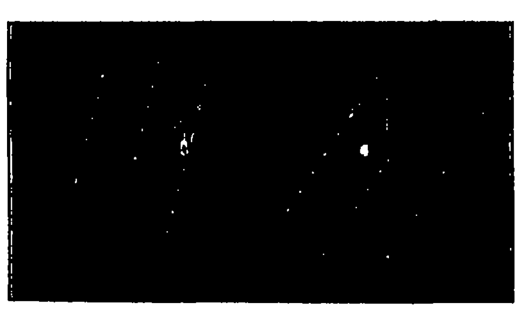


The combination helmet and suit used in escaping from a disabled submarine

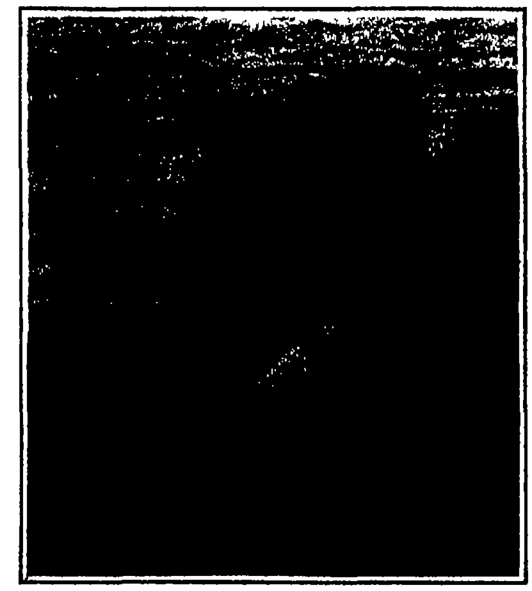


Typical prints, one with plumb bob, one with ball, showing construction for locating center of cross-hairs by means of tangents to circular photographic image

Combination Helmet and Suit Used in Escaping from Disabled Submarines

TO enable the crew of a submarine to escape from a disabled craft and reach the surface in safety has long been one of the problems confronting the leading naval powers of the world. Toward this end the British and German naval authorities are the only ones, so far as is known, who have developed a combination helmet and suit, a type of which appears in the accompanying illustrations.

The submarine escape apparatus consists of a light canvas helmet supported on a metal frame, and a waterproof suit which contains the air supply. The equipment is independent of any external source of air, working on the principle of the self-contained diving suit. Chemicals are used to regenerate the air for breathing, and it is reported that in some types of suits the supply is sufficient for a period up to 30 minutes.



Member of a submarine's crew emerging from a hatch, wearing the escape apparatus

In the event of an accident to a submarine which precludes its rising to the surface again, each member of the crew is supposed to don one of the helmets and escape, either by way of the conning tower hatch or an ordinary hatch.

Eliminating Railroad Accidents Arising from Faulty Switches

BECAUSE of the numerous accidents each year that may be directly traced to faulty switches for some time past railroad executives have been watching with varying interest the patient efforts of Ira A. Call, the young Denver engineer who intently has been developing a new type of switch.

Being of substantial design in that it uses regular rails instead of the usual form which tapers down to a point, the new switch possesses far greater strength throughout and can not be split. The design of the switch is such that it is impossible for debris, gravel, snow or ice to become lodged between its parts and interfere with its operation; it is practically self-cleaning. It provides a guard rail during passage of the switch and creates no inequality in the track that can cause breakage of flanges, axles or draft rigging. The switch can be operated from the switch stand by hand, from the tower by any one of the standard interlocking control systems, or it can be operated by the engineer from his seat in the engine cab without stopping or lessening the speed of the train, and this at any predetermined distance from one hundred yards to a mile or more. It supplements without alteration of method or plant any one of the standard block signal systems. When the last wheels of a train have passed the switch a sufficient distance to insure that cars on siding and main line will clear, the switch closes without further attention of the human element.

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Layout of the electrically-operated main line and siding switch developed by a Denver inventor

Charcoal on the Hoof

THE stumps left on a cut-over tract of timber land have always been a good deal of a liability to those engaged in the lumber industry, since it has been possible to remove them and put the land to any use only at a prohibitive cost. An entirely new departure in the technique of stump removal, which has recently had successful trials on the lands of a large Mississippi lumbering company, promises not merely to render the removal of the stumps feasible, but actually to make the stump itself an asset.

The "stump burner," shown in the accompanying illustration, is really a portable charcoal oven and still. It is set up over a stump and a burning process initiated, which continues till the stump is entirely reduced to charcoal and heavy oils, both these products being recovered. When one stump has been thus treated, the apparatus is moved to the next one.

The biggest obstacle in the way of settlement of the vast tracts of cut-over pine lands in the South has been the cost of clearing the land. This burner destroys the stump to a sufficient depth beneath the surface to permit plowing without further cutting out of roots or preparation of the land in any way. The by-products from the destruction of the stump are expected to prove valuable enough to offset the entire cost of the process of removal, if indeed the process when applied to green stumps does not prove to be commercially profitable. One ordinary pine stump has yielded as much as 17 gallons of heavy oil (after boiling off the water), in addition to the charcoal, which is of an excellent grade.


Turning stumps into charcoal with a portable oven

Fighting Locusts with Chlorine Gas

By Monroe Woolley

THERE is good in everything if we but look for it. The Filipinos have found some good in the present European war. They have learned, from the Germans, to fight an enemy with chlorine gas.

Locusts fly in the Philippines in swarms so dense that it often takes hours for them to pass a given point. The sun is obscured and the hum of their wings in flight may be heard for miles. Never a year passes but what damage to the extent of millions of pesos is done by droves of these insects throughout the scattered archipelago. Where the distance is not too great, the bugs actually cross from island to island on their riotous rampages.

It was Dr. Vivencio Rosario, of the faculty of the Philippine University, who first hit upon the use of chlorine gas to combat the locusts and he obtained his idea from the war in Europe. Experiments thus far conducted with the gas have been very satisfactory. All the locusts reached by the fumes were quickly killed and it only remains to perfect equipment for spreading the gas economically and thoroughly, without detriment to other life. Already, where locusts have not passed beyond the "hopper" stage, they may be readily exterminated with the gas—just mowed down, as it were.

But another Filipino, Señor Hernandez, director of Philippine agriculture, has an entirely different method of ridding the islands of the locust pest. He does not believe in permitting the insects to reach the hopper stage, much less to acquire wings for their missions of destruction. He would annihilate them at the cradle.


Swarm of locusts in Cavite province

As locusts destroy the crops by eating them, Señor Hernandez says they, too, must be eaten. Of course the Filipinos have been eating them as a means of getting rid of them. Roasted grass hoppers are a delicacy in all Filipino markets and have been for years. It is said they taste much like peanuts.

But a better way to eat locusts is to devour them before they hatch. Where locusts are now eaten by the thousands the clever director of agriculture would have them eaten by the millions. Señor Hernandez believes in taking his own medicine and he himself has partaken of locust eggs as a diet. He likens the dish to Russian caviar, which is made from the eggs or roe of the sturgeon.

Other people have been induced to try the eggs and they liked them so well that the egg-eating idea is spreading. Entire provinces are learning of the fine delicacy and the demand for the eggs is steadily growing. Already many people are earning money gathering the eggs for market, just as men fish for sea food or gather mushrooms for the table. The eggs are taken from the ground, are washed in warm water and are then salted.

Clam digging in this country is said to be not half the sport egg digging is in the Philippines.

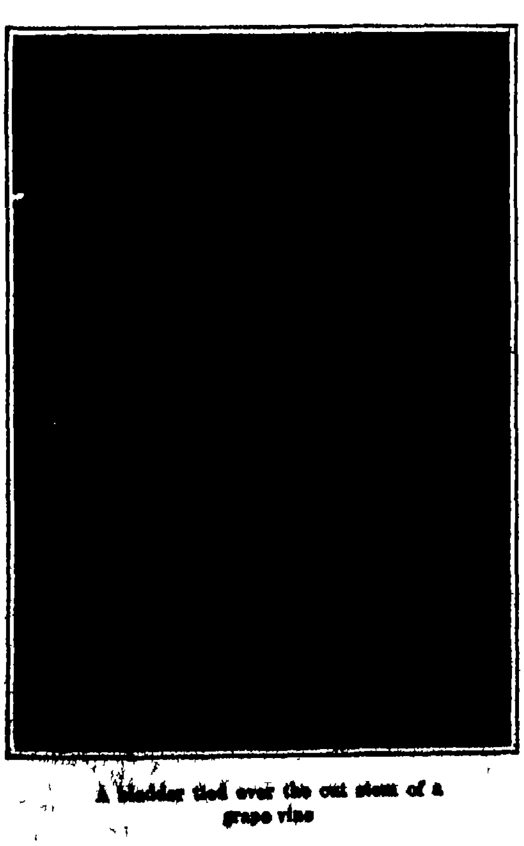
Testing the Uprush of Sap

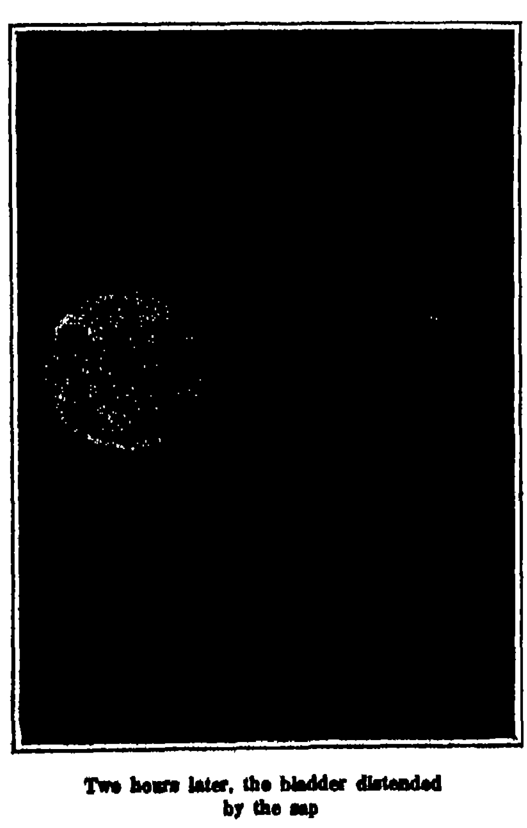
By S. Leonard Bastin

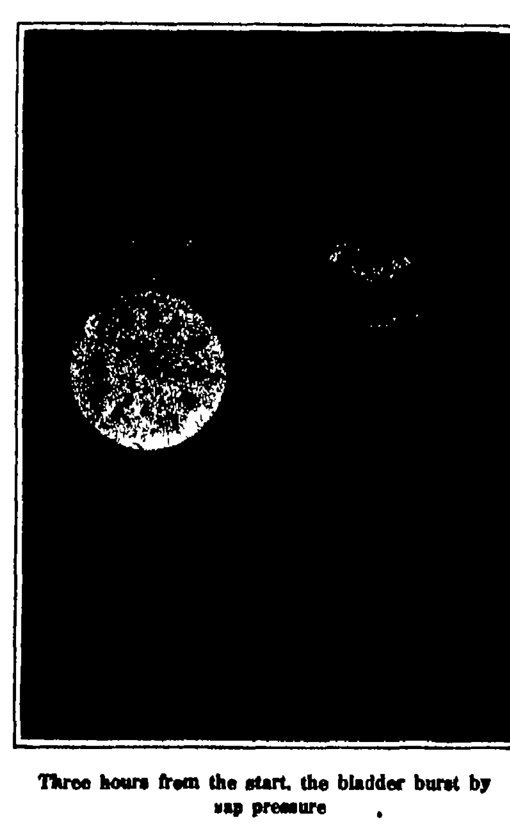
EVEN now the causes which underlie the great upward flow of sap in the spring are not completely understood. That the movement is accompanied by considerable force has been demonstrated in a remarkable manner.

In the spring season when the sap is rising with great vigor the stem of a grape vine was cut right across. With as little loss of time as possible a piece of bladder was tied over the surface of the wounded part. As fixed the bladder was in a state of collapse but it did not remain in this condition long. Within half an hour it was obvious that it contained a good deal of liquid. As time went on the amount of fluid matter increased, so much that the bladder was quite full. Two hours after fixing the bladder was so distended that it was lifted right up. An hour later the pressure had increased to such a degree that the bladder burst, being unable to stand the strain any longer.

In this connection it is interesting to recall the experiment of Dutrochet also with a grape vine stem. In this case a bent tube, containing mercury, was affixed to the cut stem in such a manner that any fluid coming from the plant would have to lift the column of quicksilver. In one of his experiments it was shown that the sap raised the column of mercury to the height of 30 inches. Dutrochet calculated that, in such a case the force exercised by the sap was five times greater than that of the blood in the crural artery of the horse. It requires no student of anatomy to appreciate the force of this statement.


A bladder tied over the cut stem of a grape vine


Two hours later, the bladder distended by the sap


Three hours from the start, the bladder burst by sap pressure

The Motor-driven Commercial Vehicle

Conducted by VICTOR W PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles

Moving a Regiment by Motor

THE movement by automobile of the personnel of the National Guard regiments having armories in Greater New York, Sunday, May 21st, to a mobilization at Sheepshead Bay Speedway was carried out as planned initially only in the case of a few regiments. Owing to the insufficient number of trucks resulting from the lack of cooperation between the military authorities and the ruling motor truck interests, due entirely to not understanding the best way to get together, most of the men were moved by B R T trains The men of the 47th Regiment, with headquarters in Brooklyn, were fortunate in having a quartermaster captain who was able to secure all the trucks he needed and who had sound ideas on how the movement should be carried on.

The trucks, furnished by local business men, included a wide range of types and arrived at the appointed rendezvous promptly The movement was scheduled to start at 8 30 A M, and all the trucks needed were reported before 8 15 A.M. These were 2- and 3-ton types principally though a small number of 5-ton trucks reported. All kinds and types of bodies were fitted some had stake-platforms, some were closed furniture vans and some had screen side express bodies All except one of the trucks were propelled by internal combustion motors, the exception utilized electric power The maximum speed of the electric was about 10 miles per hour, that of some of the lighter gasoline trucks was three times as much All drivers were volunteers and had never worked together

It will be apparent that it was somewhat of a feat to move a regiment of men with this miscellaneous collection of vehicles and hope to get them all at their destination at the same time The officer in charge was faced with the identical practical condition that would arise at the present time in event of emergency and not the theoretical ideal of a well organized transport division utilizing trucks of the same make, speed and power, with trained drivers and commanding officers

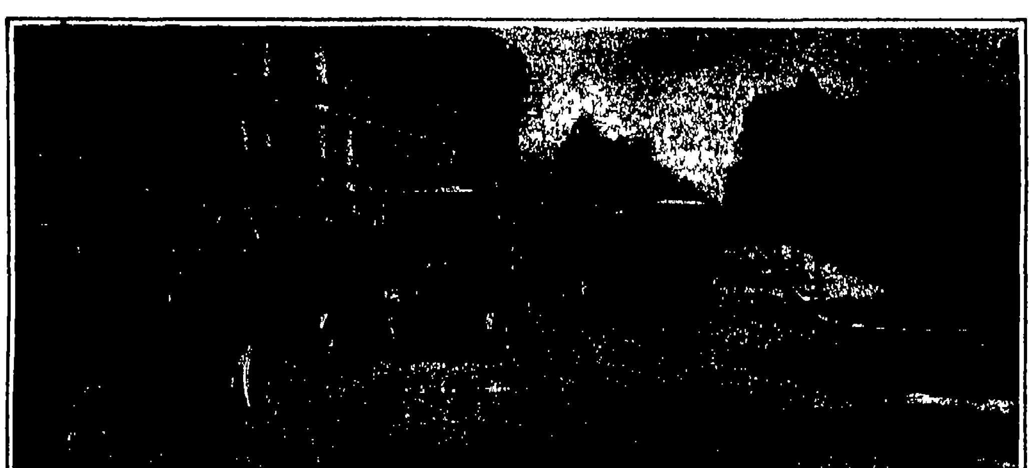
The train observed by the writer consisted of three touring cars, four runabouts and two busses for field and staff officers, three light delivery cars for the commissary department and 29 trucks for the non-commissioned officers and privates No attempt was made to provide seats, the trucks were just as they would be if a sudden call came for their services and they had to be taken from their legitimate and every day tasks for emergency use. A non-commissioned officer was seated with each driver and put in command of the truck This was a wise move on the part of the quartermaster captain as later events proved This officer, in charge of the train accompanied the writer in a high speed runabout and was assisted by a lieutenant driving his own car in keeping the units of the column moving together and all trucks in their proper places This required constant movement from one part of the column to the other, holding back the speedy trucks and hurrying up the laggards

The pace was set initially by the colonel commanding the regiment who occupied the leading touring car and was entirely too fast for the trucks The train was soon divided in two or three sections, some several blocks apart. A halt was called and all trucks allowed to get in proper position again. The pace of 12 miles per hour was then set by the pacemaker, but soon the column divided again and the fast trucks in the rear began to race in an effort to pass each other and the slower trucks of the line. At times there were three trucks abreast and the movement seemed doomed to degenerate into a free-for all race. The cause of the split was found to be the electric truck which could not maintain the pace and one large 5-ton gasoline truck which was geared very low because its normal work was moving building stone

The racing was stopped by catching the offending cars and ordering them back to their proper positions in the line. The officers accompanying the drivers were instructed to be sure that the trucks were not taken out of the column to pass others The two trucks that held up the rest were sent to the rear of the line and by halting once more for a few minutes to allow them to catch up, the train was kept intact and all the men of the regiment arrived at the mobilization point at the same time The writer was informed that this was the only regiment carried by motor trucks that arrived in this manner, as some of the Manhattan regiments arrived in sections, the touring cars and faster trucks arriving first, followed sometime later by the slower trucks.

A number of useful lessons were taught by this experience The most important was that a large body of men could be moved more expeditiously by motor trucks to any given point not reached by railroads than by any other means. The regiment observed by the writer was transported nearly 10 miles in less than an hour, and had any opportunity been afforded to select trucks of nearly the same speed range, the distance could have been easily covered in half the time.

Motor train on its way to the Atlantic Coast, showing the commanding officer in fast runabout



The movement degenerating into a free-for-all race

In future movements of this kind, it is the writer's opinion that the following points can be kept in mind advantageously First, select the truck equipment carefully, trying to use trucks of the same kind as much as possible If this is not practical, divide the train in divisions grouping trucks of the same speed and power together

Second, put each truck in charge of a responsible officer to prevent racing.

Third, electric trucks cannot be used with a gasoline truck train They are too slow

Fourth, the pace of 10 to 12 miles per hour is too slow for the majority of gasoline motor trucks as it necessitates driving in the lower gear ratios and heats the engine causing the water in the radiator to boil in a few miles

Fifth, the officer in charge of the train must have a fast, easily handled small car of higher power, as he must be able to get from one point in the column to another very quickly The under officer should also be provided with a car. Several messengers on motorcycles should be available to deliver messages from one part of the line to the other

Sixth, a master mechanic and assistants should have a reasonably fast truck equipped with the necessary tools for various roadside repairs and adjustments, carry spare parts, block and tackle, long planks, powerful jacks, lifting crane, winch, extra fuel and oil, etc., if the distance to be covered is of any moment.

Seventh, every truck should be numbered distinctly and should travel in its proper place. The numbers should be large enough to be read at a glance by the officers as they pass back and forth along the column to make sure that every truck is in place.

Eighth, an officer and messenger should be detailed to ride at the rear of the column and an experienced pacemaker and engineer officer at the head The officers in charge must be free to go from one end to the other as the conditions demand.

Ninth, the trucks must be at least two lengths or about 30 feet apart and should maintain this pacing whenever it is practical.

Tenth, two-ton trucks are amply large for the purpose of moving men. The heavier trucks are too slow for this purpose and might tax the capacity of the ordinary country bridges too much. The engineer officer at the head of the column should examine all bridges and culverts to see if they need reinforcing before the trucks pass over

It seems that a desirable point to work out in our preparedness plans is to determine the best organization for militia transport trains, keeping local conditions in mind The various makes and types of trucks in every district should be card indexed as well as the good drivers and mechanics necessary for their operation, so the selection of suitable vehicles can be worked out in advance of the actual need Closer coöperation between the military and motor truck or automobile ruling interests is essential to insure the successful use of civilian motor trucks in an emergency

Motor Truck Queries

P E R. writes. I have recently secured possession of a 40-horse-power motor truck of early manufacture and of very substantial construction I wish to change this into a tractor and I would like some idea about the amount of power necessary to do various kinds of farm work. For example, how much more power is needed for plowing than for hauling loaded wagons? How may one determine the drawbar pull available? A. You will find that the converted truck tractor will be much more suitable for hauling wheeled vehicles than it will be for plowing unless the general construction is changed materially There is a great difference in draft required by wheeled vehicles and plows. The tractive effort for moving loaded vehicles on level roads ranges from 5.16 pounds per ton weight on steel rails or plates to 400 pounds per ton weight in deep sand. A vehicle may be moved on asphalt with a pull or push of 12 pounds per ton weight, and on macadam with a pull of about 31 pounds. Dirt or gravel road will require from 125 to 250 pounds pull per ton weight. A horse-power is equivalent to a draft of approximately 187 pounds at the rate of 2 miles per hour. Where the highway surface is good, a drawbar pull equivalent to that exerted by two horses would be sufficient to pull ten tons. On the other hand, in plowing or breaking, a tractor will have to be a powerful one and have the proper degree of adhesion to the ground, if it is to

(Concluded on page 650)

LEGAL NOTICES

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Shackleton's South Polar Expedition

(Concluded from page 636)

this reason the winds to be observed on the margin of this anticyclonic area will display a more or less cyclonic character, according to the year taken into consideration

The Weddell Sea east of Graham Land, as well as the Belgica Sea west of Graham Land, belong precisely to this region of very accentuated variations The Weddell Sea probably more so than the Belgica Sea, and that is why the ice conditions of the Weddell Sea may differ so greatly

Shackleton's scientific observations will therefore be most valuable

From another purely scientific point of view it is to be regretted that Shackleton did not succeed in accomplishing his programme I have in mind the problem of the Antarctic Andes It was my pleasure to discover in 1898, that the rocks of Danco Land, of Palmer Archipelago and of Graham Land were Andean rocks The great physiographic similarity of this Antarctic chain of mountains and the southern Andes of Terra del Fuego also led me to the supposition that the Andes really reappear in Antarctica south of Cape Horn This view has since been adopted by all students of Antarctic geology

But South Victoria Land, on the opposite side of Antarctica is geologically and physiographically absolutely different It is an old table-land

In what direction do the Antarctic Andes extend? It may be that this relatively recent folding of the earth crust curves west towards King Edward VII Land or it may be that it bifurcates, as has been presumed by Edgeworth David

This important problem justified the attempt to cross the Antarctic Continent from sea to sea

Mastery of the Air vs Control of the Sea

(Concluded from page 637)

The German authorities seem to have been quite aware that in spite of their limitations the non rigid and semi rigid airships could fulfill some functions to the satisfaction of their owners—chiefly in conjunction with army operations and harbor defense, where their ease of transportation, low cost and general handiness were greatly appreciated But the Germans were none the less convinced that for strategical reconnaissances and chiefly naval scouting high speed airships, capable of long endurance, were required and that these requirements could not be attained by either one of the above mentioned types This is why, undaunted by countless accidents, many of them tragic, Germany never lost her faith in the Zeppelin and, what is more, even encouraged the development of another type of rigid airship, the Schütte-Lanz Thus when the German navy lost her first two Zeppelins, four new vessels were laid down at once, three of them at the Zeppelin factory and one at the Schütte Lanz works

It is interesting to compare this progressive policy—which at the time was called adventurous—with the hesitating attitude of the British authorities towards airships in general and Zeppelins in particular

After having tried and, generally speaking, failed to produce a serviceable lighter than air machine of original design, the War Office—which up to 1914 was alone in charge of the airships—purchased from foreign manufacturers a number of non rigid and semi rigid vessels, while the Royal Aircraft Factory furnished some small airships for instruction purposes

The Admiralty seemed for a short time to be animated by a more progressive spirit. In 1909 an order was placed with the well known shipbuilding firm of Messrs. Vickers, Sons and Maxim for a 21 ton airship of the Zeppelin type. This vessel, the "Mayfly" was launched two years later, but unfortunately broke up while she was being towed out of her shed. As it proved impossible to repair the

(Continued on page 647)

RECENTLY PATENTED INVENTIONS

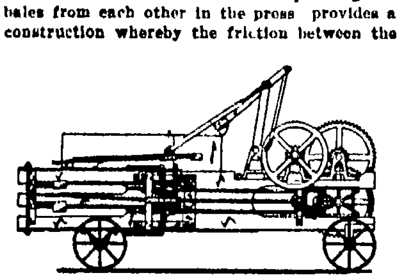
These columns are open to all patentees The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Electrical Devices

REGISTERING DEVICE FOR TELEPHONE SYSTEMS —E M NORTHUM, care of National Telephone Toll Register Co Stephens Ark An object here is to provide an improved device over that shown in a prior Patent No 1,018 981 these improvements consisting mainly in simplifying the construction of the device and the provision of means for registering the number of disks deposited in the registering device It facilitates the posting of books and the checking up of telephone calls, especially those received on toll lines

Of Interest to Farmers

SELF FEEDING AND SELF TYING MECHANISM FOR HAY PRESSES —W R SMITH, Erie Colo The inventor provides a mechanism entirely automatic in operation provides a tying mechanism that avoids the necessity for the use of head blocks for separating the bales from each other in the press provides a construction whereby the friction between the



SELF-FEEDING AND SELF TYING MECHANISM FOR HAY PRESSES

wire-tying mechanism and the wire is reduced to the minimum, thereby greatly reducing the wear on the parts of the tier, and provides a tying mechanism embodying the use of wire direct from spools or reels, thereby avoiding the necessity and expense of making up the wire into given lengths.

INCUBATOR —J W SACHSE R R 8, Shawnee, Okla The invention improves the construction of an incubator with respect to the means for supplying moisture in a regular uniform manner to the bottom thereof whereby the lower half of each egg is maintained suitably cool while the other half thereof is maintained warm, simulating in a high degree the natural method in incubation as when a hen steals her nest away and the eggs are subjected to more or less intimate contact with the cool ground.

Of General Interest

SAFE RECEPTACLE FOR VALUABLES — H. W WOODRUFF, SR., Slidell La The invention relates to locks for both portable and stationary safe receptacles for money bonds stock certificates, jewelry, etc In its portable form the safe is preferably constructed in oblong rectangular shape and is provided with a door preferably hinged to which the improvement is applied This form is particularly adapted for use in making shipments by parcel post or express or similar agencies

LIFE BOAT —H B JOYCE, 1917 9th Ave, West Seattle, Wash A purpose of the present invention is to provide a life boat with novel and removable thwarts allowing a plurality of similarly constructed boats to be nested one within the other to thus occupy little space which is such an important consideration on board a ship

BOTTLE CAP —H V CLAUSEN 29 Broadway New York N Y This invention provides a substitute for the well known crown stopper or cap whereby the waste of caps by being entirely removed from the bottle and thrown away as in the said crown caps, is avoided, the device consisting of a body member in permanent connection with the bottle the closure disks in separable connection with said body member said disks being of different types and capable of repeated use

NON REFILLABLE BOTTLE —F H LEITHEISER 181 New St New Brunswick N J This inventor provides a means for the neck of a bottle providing for free outflow of the contents but preventing the introduction of other material to the bottle after it has been emptied the means to prevent such introduction including a plurality of valve devices cooperating with the same holding means and also including a movable weight to effect the prompt seating of the principal valve

SEAL —T I COUGHLIN 519½ Grove St. Jersey City N J This invention has reference to improvements in seals used in sealing the locks of cars, safes and in fact any other desired device which it is desired to seal against opening by any one and has for an object to provide an improved structure which must be broken before the same can be removed.

FOCUSING ROLL-FILM CAMERA —E. U WRIGHT, 147 Delelan Ave, Newark, N J The primary object here is to provide a roll film camera which can be used in an ordinary way for taking snap shots or time pictures but which can also be used as a focusing camera so that a high degree of accuracy is possible in obtaining a clear image and consequently for producing a clear picture without resorting to charts or guesswork in setting a camera at the proper focus, as by means of the usual finder

FOUNTAIN PEN FILLER CONTROL.—J W CROUSER, 114 Park Place, New York, N Y The object of this invention is to provide a simple convenient and inexpensive fountain pen filler control which, when accidentally displaced on the pen, will not cause a variation in the volume of the elastic reservoir and, consequently eject a part of the ink thereof through the pen

LIQUID MEASURING DEVICE —HENRY ERNST 4231 Hamilton St, New Orleans, La This invention has particular reference to a beer measure An object is the provision of novel means connected to a receptacle for automatically indicating by the weight of the liquid therein when a predetermined amount has been poured into the same

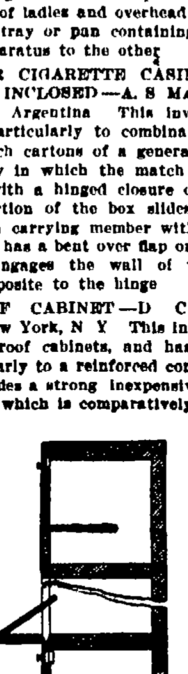
DEVICE TO FASTEN A CAMERA TO A TRIPOD —W C WHIALUP, 224 Oriole St, Rochester N Y Co-acting fastener elements are attachable respectively to the base of a camera and to the top of the tripod The camera element is mounted to rock through an angle of 90 degrees to a position pendent below the camera base or a position within the camera base The tripod element includes a cam lever which is sustained above the top of the tripod and means provided to exert a wedging and drawing action on a head on the camera element This head extends through the bolt hole in the tripod top and held against lateral displacement in effecting engagement of the co-acting fastener elements.

CLOSURE FOR CONTAINERS —A G CARLING 119 W 64th St New York N Y This invention provides a closure for bottles and other containers adapted to contain liquids for use as a mouth wash and other purposes liquid soap for shampoos or other liquids and arranged to permit of directing the liquid contents into a toothbrush or other implement or into a particular point without scattering or wasting the contents

BACKING APPARATUS —E KEEFE, care of *Collier's Weekly* 416 W 13th St New York, N Y This invention provides an apparatus which permits of conveniently melting the solder on the back of the copper shell and to then pour the molten backing metal into the solder and without danger of splashing of the molten backing metal and dispensing entirely with the use of ladles and overhead means for carrying the tray or pan containing the shell from one apparatus to the other

CIGAR OR CIGARETTE CASING WITH MATCH BOX INCLOSED —A. S MACKINTOSH, Buenos Aires Argentina This invention relates more particularly to combination cigarette and match cartons of a general type but of the variety in which the match receptacle is provided with a hinged closure over which the outer portion of the box slides It provides a match carrying member with a lid or closure which has a bent over flap or lip which frictionally engages the wall of the match receptacle opposite to the hinge

FIREPROOF CABINET —D CUOZZO, 21 Park Row, New York, N Y This invention relates to fireproof cabinets, and has reference more particularly to a reinforced concrete cabinet It provides a strong inexpensive and fireproof cabinet which is comparatively light and



FIREPROOF CABINET

in which the doors controlling the access to the cabinet constitute shelves for the cabinet when said doors are open and thus facilitate the inspection and manipulation of the subject matter carried by the cabinet

CHAIR —E T CARR Mebane, N C Operators in knitting mills oftentimes are required to attend to two machines which necessitates frequent turning around, and there has not been constructed previously, any device in the form of a chair which could be effectively employed for the purpose of aiding the comfort and work of the operator attending the machines. This invention supplies this want by providing a swinging stool mounted between two machines.

MAIL POUCH —P J LAWLER, Jackson Township, Iowa The pouch is of a collapsible character and especially adapted for use in the collection and delivery of mail matter on rural free delivery routes wherein each patron is provided with two pouches one for containing mail matter to be left at the place of delivery by the carrier, the other for containing mail to be carried away by the carrier to be mailed from the local post office

AREA GRATING —J F STECKENREITER, Calyer and Jewell Sts., Brooklyn, N Y, N Y The invention relates particularly to area or vault gratings made of wrought iron, steel or other rolled metals, such as are now commonly used for flooring over vaults, areas, steps, platforms and the like, the top surfaces of which become dangerous to the public and particularly in wet or frosty weather

CLIP.—M T GOLDSMITH 522 Mulberry St., Newark, N J This improvement provides a clip for use on fountain pens clinical pocket thermometers and other articles intended to be carried in the pocket and arranged to permit a retailer or other person to conveniently and easily attach the clip to the article with a view to securely hold the article in position in the user's pocket.

CAN CLOSURE —C H FOSS, Milaca, Minn An object here is to provide a closure for opening the top of a can, box or the like arranged with an inner and outer plate and held in place by connecting members which hold the plates in alinement while allowing a movement toward and from the opening

ELEVATOR —H C HILKE Address J O Bradney, 1 Broadway New York N Y This invention relates to improvements in elevators and is especially designed for use in hoisting lumber to be piled in stacks although it may be advantageously employed for loading upon railway cars or boats other articles, such as long pieces of structural iron

GRAVEL MACHINE —H T SYKES, New London Mo This machine is for use in excavating gravel from gravel pits whether above or below water and of the class adapted to be operated by draft apparatus arranged at a distance as for instance an endless belt, wherein a scraper is provided supported by wheels, and movable with respect to the wheels into and out of loading position and wherein mechanism is provided in connection with the scraper and the wheels for automatically lifting the scraper into inoperative position when loaded, and operated by the loading of the scraper

ANIMAL TRAP —E S CUNNINGHAM Mansfield, Mo The trap is arranged to permit of readily setting it without danger of injuring the fingers to allow releasing the dead animal without touching it and to prevent the animal from reaching the bait, thus allowing use of the bait for a considerable length of time without re-baiting after each capture

PROPELLER —C A HARTFIEL, 444 Jersey Ave Jersey City N J Among the objects of this invention is to so improve the form or design of a screw propeller as to make it more efficient or to produce a more satisfactory result as to power and speed in proportion to the amount of power expended than propellers now in common use.

SCALE READING DEVICE —H G CHALKLEY and DE WITT C CONKLING Address the latter Room 1853 50 Church St., New York N Y This invention provides a means where by the scale vertical or horizontal of any surveying instrument, transit theodolite, or level, may be read at sight to fractions of a second without a vernier or the use of a microscope which is an absolute necessity on all present style instruments reading as close as 30 seconds now known the means also being applicable to protractors and all scientific and mathematical instruments where the degrees minutes and seconds of the circle have to be read

Hardware and Tools

NUT LOCK —D M BARRINGER, Greensboro, N C This invention is an improvement in the type of nut locks in which the locking device is provided with a spring tongue adapted to engage a nut The nut lock is formed of spring material and has a flat body with a bolt hole at one end and a flat side finger parallel to said body and whose free end is offset laterally in a plane parallel to that of the body

STAY BOLT —H. A LACERDA 303 Campbell Ave., Schenectady N Y The invention provides a stay bolt for the fire boxes of boilers and like structures, and arranged to permit convenient and quick periodical inspection of the stay bolt without requiring removal of any of the parts, at the same time rendering the stay bolt steamtight and allowing movement of the boiler sheets in the direction of their plane without straining or otherwise injuring the stay bolt.

ANTI RATTLING NUT LOCK —H. B PLOPPER Litchfield, Ill. This invention provides a locking device which effectively prevents accidental displacement of the nut and rattling of the parts which is often incident to constructions of this character The nut lock is composed of a minimum number of parts and is therefore easily and inexpensively manufactured

PIVOT STRAIGHTENING TOOL.—J F DOTTER, Chester Ill The invention relates to means for straightening bent pivots on watch wheels, and provides a tool or attachment for a watchmaker's lathe which will accomplish this result without any danger of breaking the pivot or of injuring the wheel to which it is connected

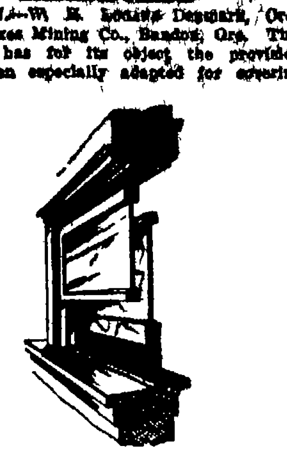
CALIPERS —M W SEVERANCE and C C HERBERT 37 Bellevue St. Lowell, Mass. In this instance the invention refers to outside calipers, and the main object is to provide such a tool which is adapted to receive and hold a rule in one of its legs whereby greater ease and accuracy of caliper adjustment is possible than with the conventional calipers.

Heating and Lighting

GAS FIRE.—H. J YATES, Essex Works, Thimble Mill Lane, Aston, Birmingham, England. This invention relates to gas fires of the type comprising a number of radiants or heating elements placed in conjunction with a firebrick back and the nozzles of a gas burner. The invention enables gas fires to be employed not only for heating purposes without contaminating the atmosphere of a room, but also to produce a more ample ventilation than has been possible with gas [illegible].

Household Utilities

SCREEN.—W. H. [illegible], Ore., care of Sixes Mining Co., Bandon, Ore. This invention has for its object the provision of a screen especially adapted for covering

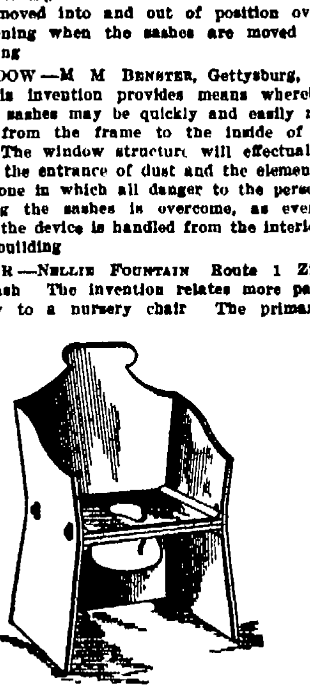


INSECT SCREEN

windows and other openings to prevent the entrance of insects and the like wherein the screens are supported on spring mounted rollers arranged in suitable openings in the window casing and are connected to the sashes, to be moved into and out of position over the opening when the sashes are moved in the casing

WINDOW —M M BENSTER, Gettysburg, S D This invention provides means whereby window sashes may be quickly and easily removed from the frame to the inside of a room. The window structure will effectually prevent the entrance of dust and the elements and is one in which all danger to the person removing the sashes is overcome, as every part of the device is handled from the interior of the building

CHAIR —NELLIE FOUNTAIN Route 1 Zillah Wash The invention relates more particularly to a nursery chair The primary



NURSERY CHAIR

object is to provide auxiliary seats having different sized openings so as to accommodate both infants and small children. Another object is to provide means whereby a receptacle may be detachably secured to the seat so as to be readily removable whenever necessary

SPOON HOLDER —W S AVERY, 2200 Highland Ave Knoxville, Tenn. This invention pertains to spoon or knife holders for use on the handles of cooking utensils, such as frying pans and the like and the main object thereof is to provide such devices which are quickly and easily placed in position, which adapt themselves to handles of different shapes and sizes and which hold spoons or knives in either flat or edge positions.

STUFFING OR PACKING.—I MARGOLIUS, care of Imperial Bagging Co, P O Box 1037 Norfolk, Va An object here is to produce a cheap and efficient stuffing or packing to be used for stuffing mattresses as packing material, as a heat insulating lining, etc. A further object is to provide a stuffing or packing which is free from objectionable odor and which is comparatively free from objectionable gum or other mucilaginous matter

Machines and Mechanical Devices

ADVERTISING DEVICE —H A. ARMSTRONG, 96 Sterling Place, New York, N. Y. This invention relates to advertising devices known as Jacob's ladders, in which there are arranged a number of individual panels and so connect each to each that under certain conditions each upper parcel drops or turns downwardly around its lower edge as an axis, causing a similar action downwardly of the next lower panel, both sides of the panel being available as supports for signs or other advertising matter

SAW MILL SHOCK ABSORBER.—G. H HAMILTON, 474 E. Liberty St., Portland, Ore. An object here is to provide a shock absorber for saw mills which will prevent the cants from striking the delivery rollers and thereby causing injury to the rollers, the foundation of the mill and also to the part of the cant projecting beyond the end of the rollers.

WEIGHING APPARATUS.—P. [illegible], [illegible] Avenue du Maine, Paris, France. This invention relates to weighing apparatus in which

(Concluded on page [illegible])

"Mayfly" and no credit was available for a new construction, the British Navy stopped experimenting with Zeppelins until 1914, when Mr. Winston Churchill became First Lord of the Admiralty. At the instance of this far seeing minister, twelve airships were laid down at once, two of which were Zeppelins, but before this building programme could be carried to completion, the great war broke out. By this time Germany had commissioned thirteen Zeppelins and half a dozen minor airships, while Great Britain possessed but three small non rigid vessels.

It is rather astonishing that the British naval authorities should not have realized any sooner the value of airships and, particularly of Zeppelins for naval scouting. In 1909 Sir Percy Scott—many of whose revolutionary" predictions regarding naval constructions have been vindicated by the great war—wrote, in a preface to Jane's *All the World's Airships*, the following prophetic words: "In gaining information of the locality, strength and disposition of the enemy's fleet and so possibly unmask his strategy an airship's services would be invaluable, for it might not be possible to obtain the information in any other way."

Twenty two months of warfare have fully demonstrated the truth of Sir Percy's assertions. Germany has been able to use her Zeppelins with marked success in many diverse functions, about which little has come to light as yet. It is noteworthy, however, that one Zeppelin was decorated with the Iron Cross "for coöperation with submarines during a successful attack on three British armored cruisers." Several Zeppelins have also coöperated with German submarines for enforcing the so-called "submarine blockade" by stopping and occasionally sinking such merchantmen as they could not bring into a German port. Other Zeppelins have been engaged in patrolling the German shores from Holland to Denmark and from Denmark to Russia, still others have played an all important rôle as fast scouts for such portions of the German fleet as have ventured beyond the range of Heligoland's coast batteries. Their participation in the latest naval raid on Lowestoft even raises the question, whether the twofold slipping of the British blockade by the German commerce raider "Moewe" may not be attributed to intelligent coöperation between her skipper and one or more Zeppelins. The high speed of these airships and their faculty to send, as well as to receive wireless messages makes this assumption appear quite plausible.

German official reports seem to omit purposely all reference to this sort of work done by Zeppelins while particular emphasis is laid on the destruction achieved by Zeppelin raids against the British Isles. These incursions on undefended shipping and manufacturing towns—however contrary to laws of civilized warfare they be—come well within the German definition of "commerce war," as practiced by German naval forces on several occasions ("Vide" the raids on Scarborough and Lowestoft, the bombardment of Madras by the "Emden" and that of Papeëte (French Oceania) by Admiral von Spee's squadron, the latter instance is particularly enlightening, as all the shells were deliberately aimed at the business section of that port.)

From a military viewpoint the Zeppelin raids on England are of comparatively small importance, though some of them may have served the purpose of a reconnaissance in force," either for ascertaining the whereabouts of Sir John Jellicoe's Grand Fleet or else for reconnoitering the location of English coast defense works. If such really was their purpose, then the dropping of bombs was successful from the German point of view, as it forced the British to disclose the location of their batteries by firing on the air raiders.

There still is another important function which Zeppelins may fulfill with a fleet gun spotting. During the Gallipoli campaign the "Queen Elizabeth" repeatedly fired across the peninsula, hitting targets invisible to her gunners, the cor-

(*Concluded on page 649*)

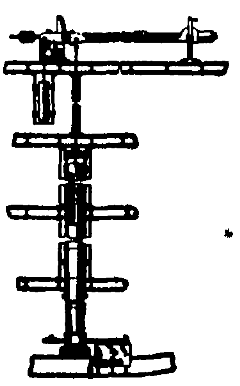
(Concluded from page 646)

the evaluation of the weights is obtained by measuring the tangents to the angles of inclination of the beam according to the principle set forth in United States Patent No 050 528 The present invention makes it possible to read directly and at any moment both the gross weight and the net weight of the article without the necessity of knowing the weight of the tare or of making any calculations

ENGRAVING MACHINE—S Clark, 241 Virginia Ave, Jersey City, N J This inventor provides an engraving machine in which all lost motion is reduced to a minimum, whereby work of better quality is obtained in which machine there is direct interaction between the stylus point and the needle point and which machine can be easily and quickly adapted to various classes of work

STUMP PULLING AND HANDLING MACHINE—G Lehnherr, Pittsville Wis The invention relates particularly to a turntable construction forming part of a stump pulling and handling machine, the object being to provide an arrangement for directing the boom of a derrick in the machine together with actuating means capable of imparting movement to the turntable at a plurality of points thereof

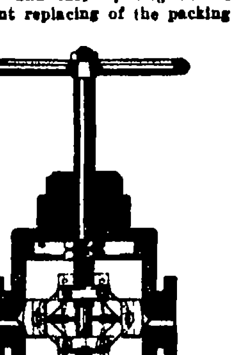
SHIP SCALE—J Frame Searsport, Maine This invention relates particularly to a scale adapted for weighing a ship and the cargo while in the ship It provides an arrangement whereby a correct weight may be secured of the load as the same is placed in the ship



SHIP SCALE

regardless of the position of the load and of the scale It provides a scale with means for compensating for the pitching of the ship during the loading so that a correct reading may be presented regardless of whether or not the ship is on an even keel It also provides that a correct reading may be provided upon the beam connected with the weights according to the degree of submergence of the plunger

VALVE—W A Bartz, 412 Congress St Schenectady, N Y This invention provides a valve arranged to provide an effective closing of the valve and easy opening of the same and convenient replacing of the packing while



VALVE

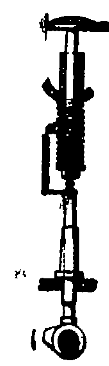
the valve is closed To accomplish this use is made of a valve casing having an inlet and outlet valve arranged within said casing and adapted to open and close the inlets, a valve spindle mounted to turn in the casing and having threads a nut screwing on said screw threads and links pivotally connecting said nut with said links.

APPARATUS FOR TREATING ARTICLES OF GLASSWARE—I Kauffeld Address W J Wambaugh care of Star Glass Co Star City W Va The invention relates more particularly to an apparatus for treating lamp chimneys and similar articles requiring the heating of the edges thereof the apparatus being of that type in which provision is made for giving the glass articles a revolving movement on their own axes whereby to prevent collapsing of the edges when heated

SCHOOL LOOM—Elizabeth I Botts P O Box 617 Butte Mont The object of the invention is to provide a school loom more especially designed for use in schools to teach children the rudiments in the art of weaving and to permit the weaving of tubular fabrics single or double with flat fabrics two flat fabrics and the like in various colors and materials

FABRIC CLAMP—C J Priester care of Kretsch & Priester 25 Bleecker St, New York, N Y This inventor provides an apparatus for holding fabric while the same is being piled or otherwise operated upon provides an apparatus readily adjustable to piles of various thicknesses, and insures the operation of said apparatus on fabric irrespective of the thickness of material or the number of piles forming the same

MOTOR—Z A Berggoer, P O Box 581 Williston N D This invention is an improvement in motors and the invention has for its object the provision of mechanism in connection with the puppet valves of motors



MOTOR

for eliminating the noise generally between the tappet and the valve during the operation of the valve The improvement may be attached to existing engines without changing the engines themselves

CARBURETER ATTACHMENT—E Waldmeier Cor 27th Ave and 14th St. Gulfport Miss. An important object of the invention is the provision of a regulating device especially adapted for use in connection with engines having self starters, and operated from the driver's seat of a vehicle to close the air inlet for the carbureter in order to supply the same with more gasoline whereby the mixture is made richer

CARBURETER—B H Schmidt 17 E 48th St., Minneapolis, Minn This invention prevents the congelation of the gasoline and the sluggishness consequent thereon, provides a regulator automatic in character for increasing the fuel supply for an engine in proportion to the increased speed thereof provides means for thoroughly mixing the fuel, the mixture being perfected in proportion to the supply thereof and provides for quickly and readily dismantling the carbureter for repair or cleaning

BUTTON FEEDING MECHANISM—B Kotkovsky 299 Broadway New York, N Y The invention relates to a feeding mechanism for feeding shoe buttons and the like to an attaching mechanism such as a staple forming and driving device It provides effective means for picking up buttons in a hopper, arranging them in a predetermined order and supplying them in such order to a button feeding chute

SHUTTER OPERATING ATTACHMENT FOR PHOTOGRAPHIC CAMERAS—H C Atwood Box 362, Nocona Tex The attachment operates the shutter of the camera to which it is attached and giving the correct time of exposure The operator sets the attachment to give the desired length of exposure at a desired length of time thereby allowing him any specified length of time to place himself within the range of the camera and thus be a part of the object included within the range of the camera when the exposure is made The shutter operating device may be attached to any camera whose shutter is operated by a thumb lever, such camera not being already provided with such means of shutter operation

POWER TRANSMISSION MECHANISM—A O Boyland Aurora Neb The mechanism is designed to connect a wheel or wheels to a shaft upon which the wheels are mounted for transmitting the rotation of the wheel or wheels to the shaft or that of the shaft to the wheel and wherein the arrangement is such that the plane of the wheel or wheels may be inclined with respect to the axis of the shaft without interfering with the driving connection

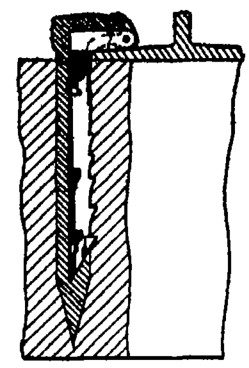
BUTTON ATTACHING MACHINE—B Kotkovsky Address Rapid Button Attaching Machine Co 299 Broadway New York, N Y This invention has to deal more particularly with improvements in the mechanism for making the button attaching staples and driving the same after a button is applied to the wire blank from which the staple is formed. The invention improves and simplifies button-attaching machine of the type disclosed in Letters Patent Number 1 134 078 formerly granted to Mr Kotkovsky

TENSION CONTROL—M. C Hatton, Upland Cal This improvement refers to tension devices for controlling the winding or unwinding of thread from reels or bobbins, whereby the thread on the reel will not become slack and will not tangle The device is automatic in its action and starts the rotation of the reel carrier when the thread begins to wind or unwind from the reel

BUTTON EDGE GRINDING MACHINE.—P F Dusha and A Feyk address Holub Dusha Co, 1797 1st Ave., New York N Y This invention relates to a machine for shaping and finishing the edges of pearl, shell and other buttons. It provides a machine of this character by which the edges of buttons can be ground or cut in various designs in a quick, simple and effective manner

Railways and Their Accessories

RAILROAD SPIKE.—J Heikkila, 711 Hammond Ave., Superior, Wis. The invention provides an anchoring device adapted to be automatically operated to embed itself in a railroad tie and to be locked to the spike

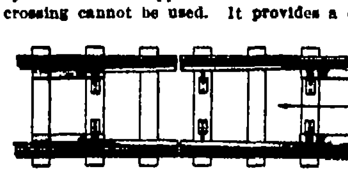


RAILROAD SPIKE

when the latter is driven into the tie It provides a latch pivoted to the anchoring device and operated when said device is actuated to engage the head of the spike to securely lock the parts together

SEARCH LIGHT ATTACHMENT FOR LOCOMOTIVES—J H McPartland Houlton Maine The searchlight is preferably placed on top of the locomotive or car and provided with means whereby the light will be automatically tilted to direct the light rays upwardly at any angle corresponding with the direction of travel of the locomotive or car and vertically when the locomotive or car is standing still, whereby, at night accidents at crossings and collisions between trains or cars will be minimized

RAILWAY GATE—J E Fiking, Bradleyville Mo This improvement provides a safety device for the crossing which may be so operated on the approach of a train that the crossing cannot be used. It provides a device



RAILWAY GATE.

in which a safety device is provided for obstructing the roadway so that the user of the crossing cannot cross the track but which will permit him to pass the obstruction if by chance he should be on the track

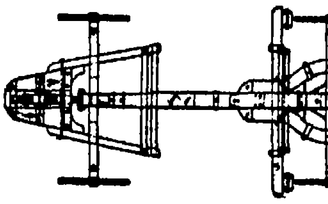
LIGHT SHIELD—E F DeWitt, 9 1st St Troy N Y This invention relates to light shields of a kind suitable for general use and also for light shields especially adapted for use upon street cars and in various other kinds of railway vehicles. It may be used to advantage in carriages, boats automobiles, and the like The lamp is provided with a metallic shield which serves as a reflector for the light and also for directing diffused light along a somewhat restricted path

Pertaining to Recreation

AMUSEMENT APPARATUS—B Hess care of Kerschner 1717 Lexington Ave New York N Y In this instance use is made of an undulating track, a truck mounted thereon and supporting a circular box open at the top and a passenger car body mounted to travel freely in the said circular box by its own weight and in a direction according to the inclination of the truck on the said undulating track

Pertaining to Vehicles

WAGON BRAKE—E. G Doland, Starksboro, Vt This invention relates to a wagon brake in which the brake is automatically applied by the backing of the draft animals as shown in United States Letters Patent Numbers 944,080 and 980 076 formerly granted to Mr Doland The invention has for its object



WAGON BRAKE

to improve, in various particulars, brakes of the class referred to whereby to increase the reliability of the brake devices and their operating means and to provide a wide range of adjustment to the various operative elements and provide for convenience of adjustment and increased strength.

VARIABLE LIGHTING DEVICE FOR VEHICLES—A. R. Colgin, 916 Napier Ave., Richmond Hill, L. I, New York, N Y The object here is to provide a lighting device for automobiles and other vehicles and arranged to permit the driver to use it as a strong headlight, a dimmed headlight or a side light for illuminating signs and other objects at the sides of the roadway.

TRACTOR WHEEL.—N L Olson, [illegible] Mass Ave., Highland Park, Mich. The improvement refers to wheels and particularly to power or traction wheels and provides a simplified construction which may be [illegible] coupled up so as to have a direct drive or a slow or fast drive. It provides a tractor wheel which may be adjusted for producing different speeds as may be desired.

STEERING DEVICE FOR AUTOMOBILES AND THE LIKE.—L. A. Peterson, address R Tjader, Darien, Conn. This improvement relates to steering devices for automobiles or the like, and has particular reference to means to prevent unnecessary and undesirable lost motion and freedom of movement of the steering post under the influence of natural roadway tendencies to cause vibration of the steering mechanism from the wheels

SANDING DEVICE FOR AUTOMOBILES—C. L Lincoln, 2828 Clarendon Road, Brooklyn, N Y, N Y The improvement provides a sanding device for automobiles and similar vehicles and arranged to permit the driver of the automobile to control the discharge of the same or other dry, non packing material, either in a large quantity at the peripheral face of the drive wheel and the roadway, or in gradually lesser quantities on the roadway in front of the drive wheel

FAN ATTACHMENT—C E. Goss, 1314 N Chad San Angelo, Tex This invention provides auxiliary fan blades attachable to a fan having permanent blades whereby to increase the fan surface by attaching the auxiliary blades or reducing the fan surface to its normal area by detaching the auxiliary blades. It is more particularly intended for use in connection with the fan employed on the Ford car

SHOCK ABSORBER.—G W Cooper, address H S Johnston Attorney, Perry Okla. One of the principal objects of the invention is to provide a device adapted to take up and absorb shocks and rebounds imparted to the springs of a vehicle and to subdue and control the side sway of the springs, thus easing and cushioning the motion of the vehicle and adding greatly to the comfort of its passengers.

SPRING WHEEL.—J C Koch, Tower City, N D An object of this improvement is to provide a spring wheel in which the felly is resiliently connected with the hub in such a manner that the springs of the wheel will yield to a partial turning of the felly relative to the hub, and thereby absorb the shock of a sudden stop or start.

SPRING WHEEL.—O W Smith Carrollton, Ky This invention relates particularly to spring wheels, and provides a construction of spring wheel by which all lateral strains as well as the torque of movement may be taken up without danger of displacing the parts or creating undue friction in the operation thereof

TRACTOR WHEEL.—M S Eby Sorrento, La The invention has for its object the provision of a wheel adapted for use with traction engines mowing and reaping machines and vehicles of like character which operate on

TRACTOR WHEEL.

plowed ground, woods or other soft land where a maximum pull with a minimum weight is desired, and which applies power to or derives power from the point of engagement with the ground.

VALVE CONTROLLING DEVICE FOR TANKS.—J P Geraghty, care of P R. R., 5th and Henderson Sts., Jersey City, N J This valve is more especially designed for use on automobiles and other power vehicles and is arranged to control the flow of gasoline from the tank to the carbureter so as to interrupt the supply of fuel to the internal combustion engine of the vehicle, with a view to prevent unauthorized persons from running away with the vehicle

Designs

DESIGN FOR A CANOPY FOR GAS AND ELECTRIC FIXTURES.—E Schwartzman, 15 Laight St., New York, N Y This ornamental design and the three other designs following, all by the same inventor, are distinguished by chaste, graceful and original lines of form and attractiveness. DESIGN FOR A SHOWER PLATE FOR GAS AND ELECTRIC FIXTURES.—DESIGN FOR A SOCKET COVER FOR GAS AND ELECTRIC FIXTURES.—DESIGN FOR AN OVAL BASE FOR GAS AND ELECTRIC FIXTURES.

Note.—Copies of any of these patents will be furnished by the [illegible] for [illegible] each. Please state the name of the patentee, title of the invention, and date of this paper.

rect range being given by seaplanes through wireless.

But seaplanes cannot yet—on account of their short radius of action—cruise with a fleet out to sea, it is true that they might be carried on motherships, but in this case their movements will be dependant on their floating bases, whereas Zeppelins may cover 1,000 nautical miles independently. The advantage then lies obviously with the airship, the more so as the latter might spot the guns while remaining stationary and send, as well as receive, wireless messages—things a sea plane cannot do.

The British Admiralty seems to have at last awakened to the realization that Zeppelins constitute excellent naval scouts and that a lack of them places a fleet in an appreciable handicap against an enemy possessing such airships. This view was frankly voiced by Mr. Balfour, First Lord of the Admiralty, in the House of Commons.

"It is extremely desirable that we should have lighter than air machines in order to supplement the efforts of our fleet by machines which, in many respects and in favorable weather, are far more effective than the swiftest destroyer or the most powerful cruiser. Therefore we have done and are doing our best to develop lighter than air machines."

These words are particularly interesting in view of a report which reached here last November, stating that Great Britain contemplated building 50 Zeppelins and other airships within two years, where after sufficient vessels would be laid down each year to insure complete mastery of the air. Provided this report is true, it will be interesting to watch the development of Great Britain's bid for aerial supremacy—and Germany's answer.

A Novel Device for Making Deviation Tests or Surveys in Deep Drill Holes

(Concluded from page 642)

well defined image of the cross hairs projected onto the disk of photographic paper at the other end of the tube by means of the objective lens, interposed at the proper focal distance between the cross hairs and the paper. It is then merely a matter of analytic geometry to calculate the precise amount and direction of both dip and strike.

In plotting the points at which the readings are taken, it is assumed that the curvature of the hole is uniform between readings, and the coordinated distances as indicated on the paper disks from center of cross hairs to vertical and horizontal diameters are considered as tangent offsets to the axis of the hole.

It is claimed that this instrument is well adapted for use in inclined holes as well as vertical ones, and as the general design is on the longitudinal plan, it is equally available for holes of small diameter. It is capable of a high degree of accuracy, because the methods by which the plottings are derived provides good geometrical leverage. It is independent of magnetic influences, and holds its adjustment very well, being quite rugged in all its parts. It is well adapted to being lowered into the hole on a cable, except when there is great pressure of water in the hole, or when the hole is nearly horizontal or actually pointing upward. For such cases the form is modified. The battery is placed within the tube together with an automatic circuit maker and breaker which renders the apparatus entirely self-contained and the instrument is then screwed to the drill rods.

Eliminating Railroad Accidents Arising from Faulty Switches

(Concluded from page 642)

The lines of construction of the new switch are simple. Four full rails from 12 to 20 feet in length, according to the length of lead required, are arranged in two pairs. A train approaching for the main line is received on one rail of each pair and guided on to the regular main line rails. A train approaching for the siding is received on the other rails of each pair and guided on to the regular siding rails. The heel of the switch is

fixed in alignment with the rails of main line and siding. The toe of the switch moves right or left 4½ inches to align the main line approach rails with either the main line switch rails or the siding switch rails. A main line train travels directly forward on a full rail. A siding train merely takes a curve on a full rail without the slightest irregularity in the trackage

In the electrically operated switch invented by Mr Call the movement of the switch is effected solely by the action of a motor of either 3 or 5 horse-power, according to the speed of movement required by traffic conditions In instances where the electric current fails or in similar emergencies the switch can be thrown by hand The control of the motor is vested in the regular track current, either direct or alternating, as in present use The engine carries an insulated shoe connected with a push button in the engine cab, the other terminal of the push button being connected to the frame of the locomotive which in turn makes contact with the regular rails through the wheels Approaching the switch at ordinary speed the engineer, if under orders to take the siding, depresses the button just as he is passing over a short length of rail that is placed in the middle of the track and on which presses the insulated shoe This auxiliary rail may be located at any suitable distance from the switch in the direction of approach The depressing of the button causes the circuit between auxiliary rail and usual rails to be closed which starts the motor and throws the switch At the same time the signal is set automatically If either the engineer the contact the current or the motor fails to operate, the signal bars the way If the engineer disregards the signal he continues on the main line in which case he must back up and operate the switch by hand in order to take the siding

When the train has passed into the siding a distance sufficient to allow its cars to clear any train on the main line the last wheels pass out of an electric block and the current, ceasing to pass through the wheels which offer a path of low resistance, must pass through its normal course of far higher resistance, which sets the motor in motion once more and returns the switch to its normal or main line position While the train is passing from the contact rail to the end of the block in the siding the switch is rigidly fixed in its position.

As the train emerges from the siding to the main line, the first wheels enter the electric block again and the switch is operated to side line position once more from which it returns when the last wheels have passed out of the other end of the electric block. Right here it is well to mention a remarkable feature of the switch should the current fail so that the switch is not automatically set to side line position to allow the train to pass on to the main line the train can still trail through the switch when it is set in the wrong position without damage to the switch or danger to subsequent traffic

The fundamental feature of the new switch rests in the heavy steel bed plates on which the four rails of the switch are laid Heavy steel studs as pivots fix each pair to the plates at the heel and the whole play of the switch is on these plates attaining a certainty of operation and a resistance to traffic impact and torsion that is said to be superior to that of the regular rails. The creeping of the steel due to traffic or temperature, which hitherto has been an absolute barrier to any type of full rail switch, is claimed to be completely offset The inventor estimates the saving effected by the switch over the conventional types at upward of 30 per cent Old type switches may be replaced singly without affecting in any way any other switch or frog on the track layout.

Motor Truck Queries

(Concluded from page 644)

do an amount of work worth while. Soils differ greatly in their cohesive properties and the amount of work re-

quired to operate a single plowshare will vary within wide limits. In an old English test made in five different soils with a share turning a furrow 5 inches deep by 9 inches wide, the average draft required was as follows: Loamy sand, 227 pounds; sandy loam, 250 pounds, moory soil, 280 pounds; strong loam, 440 pounds, blue clay, 661 pounds. The situation may be summed up by saying that for ordinary widths and depths of plowing the draft per square inch of cross section ranges from a minimum of three pounds in sandy soil to 10 or 15 pounds in turning the sod of the virgin prairie. The average tractor will not deliver more than 50 per cent of its brake-horse-power at the drawbar In a remodeled truck, unless the driving system were carefully rebuilt and proportioned to obtain low speed and permit the engine to run at its most efficient speed, the proportion would not be as high as this. An engine that would deliver 40 horse-power under the belt might not deliver more than 10 horse-power in drawbar pull The drawbar pull may be easily determined by a simple device known as a traction dynamometer, which is nothing more than a powerful spring balance which is attached to an immovable object at one end and to the truck to be tested at the other The writer would not advise the owner of a motor truck to go to the expense of changing this to a traction engine unless the proper facilities for doing the work economically are at hand On the other hand, the truck may be used for hauling all types of vehicles and farm appliances requiring but little draft without making any material changes. The amount of hauling the truck tractor can do depends entirely upon the drawbar pull and the condition of the road surface over which the load is to be drawn A drawbar pull of 10 horse-power would be equivalent to 1,870 pounds at a speed of 2 miles per hour

P E R. writes Can you give me any information relative to the process of making a rubber filling for tires in which gas is included under pressure? Is there any simple device for testing life, resiliency, etc., of solid rubber tires?

Answer The substance you refer to is of German derivation and is offered as a substitute for air in tires It is called "foam rubber" or "sponge rubber" and is very similar in structure to the sponge rubber erasers used by artists and draftsmen. It is produced by heating the raw rubber in a steel container and when the rubber is soft and sticky, nitrogen is admitted to the container under a pressure of about 6,000 pounds to the square inch The gas is admitted at an intermediate temperature and at this high pressure a large percentage of it is absorbed by the rubber The heating process is continued until the rubber is vulcanized and after vulcanization is accomplished the pressure is partially released and the nitrogen returns to its gaseous condition and when it reaches its free state it is capsuled and imprisoned in millions of minute rubber blisters, the pressure remaining from 125 to 150 pounds per square inch The original amount of rubber is swelled to five times its former volume and the substance is pressed directly into the tire casing Machines have been designed for testing the hardness of rubber, these indicating the various degrees of hardness in terms of resistance to depression of a plane rubber surface by a standard spring pressing on a blunt pin. The elasticity is shown in terms of resistance to permanent deformation or tearing The "elastometer" is adapted for testing the elastic qualities of the rubber while the "durometer" serves to try the hardness.

F A. H. writes Is there any test on record of cars having been driven successfully for any length of time without differential gear or with a solid shaft passing through a live rear axle?

Answer Four or five years ago a racing car won a 500-mile race on the speedway at Indianapolis and was without a differential. The Fifth Avenue Coach Company, of New York, has operated one of its busses without a differential gear for 20,000 miles and contrary to the expectations it was found that the rear tires had covered about 15,500 and 16,000 miles,

respectively, which was greater than the tire life of approximately 11,000 miles which is the average on these busses. It is said that there is less skidding when braking on a solid axle than on the split type with differential gearing between the two wheels. A prominent axle maker has also been experimenting with its stock product from which the differential gears have been removed and satisfactory results were obtained after stronger axle drive-shafts were made to compensate for the increased stresses in that form of axle While there is considerable discussion pro and con the writer does not believe that tests have been carried far enough to demonstrate that the differential can be entirely eliminated under all conditions of motor car operation with the same degree of success.

NOTES AND QUERIES

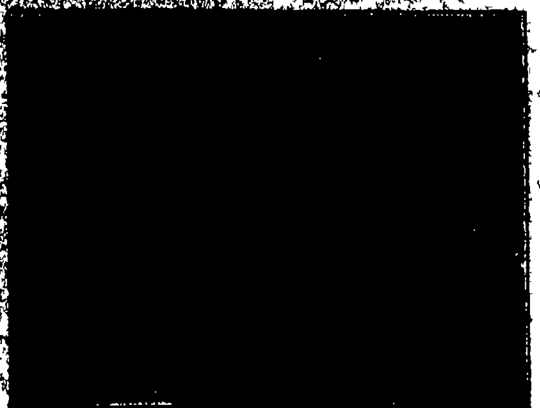
Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents subscriptions books, etc This will greatly facilitate answering your questions as in many cases they have to be referred to experts The full name and address should be given on every sheet. No attention will be paid to unsigned queries Full hints to correspondents are printed from time to time and will be mailed on request.

(14107) W B H asks Please tell me in the columns of your paper the normal temperature of small fish, such as gold fish I have been told that a fish is as cold as the water they rest in A Fishes are classed in zoölogy with the cold blooded animals, the temperature of whose blood is either that of the surrounding medium or very little above it.

(14108) F B A asks Can you paper explain a very curious experience I had in a hotel fire here recently? It was a three-story building, the rooms were all sheathed with North Carolina pine The roof had fallen in and the two upper stories were all ablaze I entered the billiard room on the first floor and the outside walls were all ablaze, the flames seemed to be sucked through the sheathing by a powerful draft, not a blaze or particle of smoke coming into the room I unhung a picture 2 feet from the blazing wall No heat, smell of heat, or smoke, was noticeable anywhere in the room It seems to me to be a very unusual occurrence There was not a particle of air stirring at the time of the fire 7 30 A M A The fact that the billiard room in the fire about which you write was free from fire and smoke was probably due to the outward draft of air caused by the burning of the walls of the building from the outside Had the fire been on the inside, the draft of air would have been inward and there would have been smoke in the room

(14109) M D Catton asks I have been informed that several telegraph messages could be sent over the same wire to the same place at the same time but from different stations perhaps, Could you kindly give me information as to the old Quad," as they called it, with two men at each end of the wire, one sending and the other one receiving respectively also inform me as to the truth of the first statement? A You are correctly informed that several messages may be sent over one wire at the same time In duplex systems one message is sent each way over one wire, and in the quadruplex system two messages can be sent in each direction at the same time Then beyond quadruplex telegraphy is the Phantoplex, a system which permits an additional transmission of signals over a wire that is at the same time being operated as a single, duplexed or quadruplexed circuit without interference between the two modes of signaling You will find these systems described in Mc Nichols ' American Telegraph Practice, price $4 We shall be pleased to receive your order for a copy

(14110) G W G asks: To decide a controversy as to how fish absorb the oxygen from water through the gills is this done and the element changed chemically in same manner as air is handled in the human or animal lungs? Is oxygen taken from the water in the process and is it returned by agitating the water in any manner whatsoever? As well known, water is practically incompressible, is it possible for the smallest quantity of air to remain in water air to be forced in, or as contended, "all water has minute particles of air always present"? A All natural water has air dissolved in it in sufficient quantity for the use of all aquatic animals and plants. These take the oxygen from the dissolved air and use it as we use oxygen from the air. This oxygen is not obtained by decomposing the water, as your remark seems to suggest. The oxygen is used by fish to oxidize carbon, forming carbon dioxide. Air is constantly being dissolved in water wherever air is in contact with water It is more easily dissolved in running water since such water is continually being carried down from the surface and other water is continually brought up from below into contact with the air The air dissolved in water is not present in bubbles and does not affect the compression of water to any considerable degree. You cannot see this air even with a powerful microscope.



EDITORIAL ROOM OF THE "SCIENTIFIC AMERICAN"

SCIENTIFIC AMERICAN

ESTABLISHED 1845

"SEVENTY YEARS OF PROGRESS"

MUNN & CO., Inc. PUBLISHERS

SUBSCRIPTION PRICE, $3.00 PER YEAR

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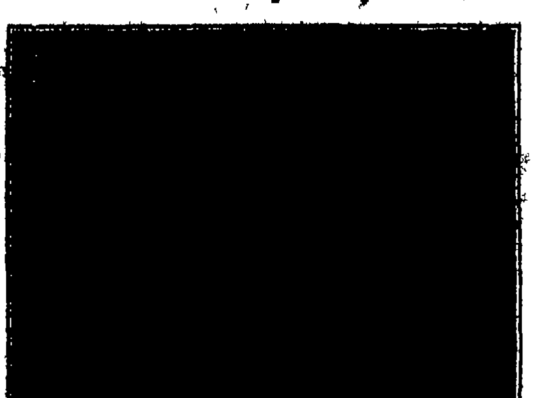

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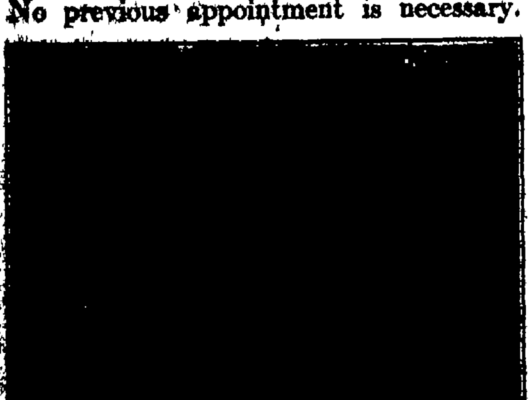

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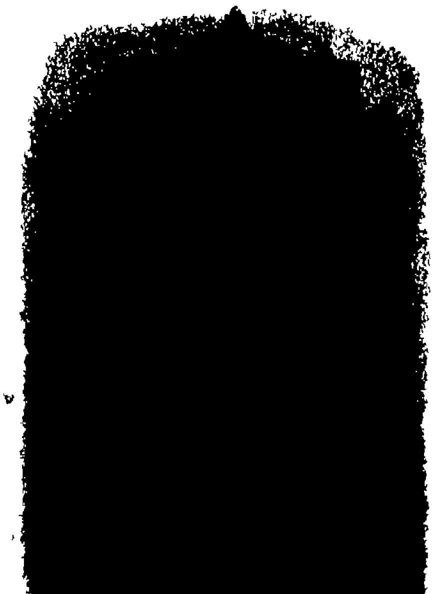

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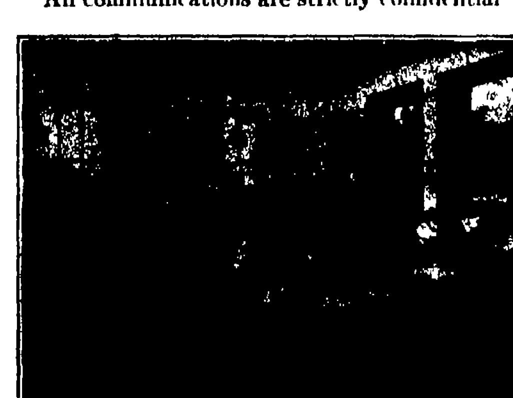


DRAFTING DEPARTMENT

SCIENTIFIC AMERICAN

STARTING A TUNNEL WITH A PNEUMATICALLY OPERATED ROCK EXCAVATING MACHINE [See page 657]

June 24, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

SEVENTY-SECOND YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIV NUMBER 26 | NEW YORK, JUNE 24, 1916 | 10 CENTS A COPY $3.00 A YEAR

Rock Tunneling Without the Use of Explosives

SOME 40 feet under the surface of Forty second street, one of New York's busiest thoroughfares, a machine is hard at work chipping out foot after foot of solid rock in pushing through an eight foot tunnel of its own making. Already the machine has pierced the rock to a distance of 70 feet, with—at the moment of writing—some 30 feet more to go to complete its present task, which is the boring of a connecting tube between the new Lexington Avenue subway and the

Front view of the rock excavator, showing the chipping hammers and rotary head

present subway, in front of the Grand Central Station.

The present rock tunneling machine is the fruit of the work of Oliver O. App, of New York, who has devoted a great number of years to the subject of rock drilling. In its main essentials the machine he is now using does not vary to any great extent from that described in the SCIENTIFIC AMERICAN for January 10, 1914, yet a vast amount of improvement and refinement has been incorporated into the apparatus in developing it to a commercially practical stage.

The rock-excavating machine may be described as consisting of three main members: first, the rotating head, which carries 14 powerful pneumatic chipping hammers; second, the carriage or main member which is provided with means for turning the head and for feeding the front part of the machine steadily toward the tunnel face; third, shovels and a belt conveyor for picking up and carrying to the rear the broken rock or muck resulting from the action of the chipping hammers. The machine is absolutely automatic in operation although adjustments, such as moving the rear portion of the machine forward at intervals and setting the chipping hammers and tools, obviously require the presence of an operator.

The rotary head carries the chipping hammers adjustably mounted on a pair of cross arms, which in turn are mounted on the main shaft of the machine—a tube 12 inches in outside diameter with an 8 inch bore, through which compressed air or any other suitable agency of motive power is supplied to the rock hammers. In operation the head turns at a slow speed, so as to bring the hammers in contact with every part of the tunnel face, and as they chip away the rock the leading part of the machine is automatically and steadily moved forward by means of screw jacks that have a total feed of 36 inches, the rear portion of the machine being held securely in place either by screw jacks which engage with the roof of the tunnel or by clamps placed on the track on which the machine travels, just in the rear of the second pair of wheels. The track is of standard gage, 4 feet 8½ inches, and is moved forward at certain intervals as the excavator progresses with its work. Whenever the screw jacks have pushed up the head to the desired limit a clutch is thrown in which operates them in the opposite direction pulling up the rear portion of the machine toward the face of the tunnel. The rear end of the machine is then secured in place, either by jacks or track clamps, and after the few minutes taken for this readjustment the machine is ready to proceed with the work.

The idea of drilling through rock with a battery of pneumatic drills is not a new one, and in the past machines capable of drilling through the hardest kind of rock formation at a surprising rate of speed have appeared from time to time. However, the basic principle of these machines has been wrong in most instances, for the designers have depended on the reciprocating action of the drill for cutting away, or rather pulverizing, the rock face. While such work as they have accomplished has been carried out in record time, the constant jar or vibration of the rapidly oscillating pneumatic drills has caused the self-destruction of the machines in a short space of time. Then again, the constant renewal of the tools used in such machines has formed an important and expensive item which has counted heavily against their commercial application.

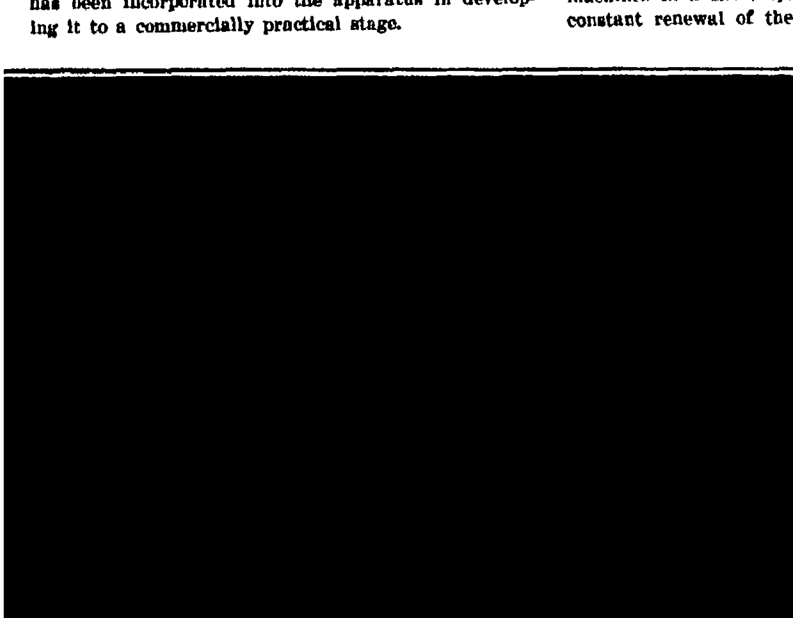
There is only one practical way of cutting rock and that is the method used by the stonecutter: the cutting tool is brought to bear on the projection to be removed and is then given a sharp blow with a mallet or hammer, chipping off a piece of the rock. So long as the tool is brought into firm contact with the rock before the blow is delivered it sustains no appreciable injury

Rear view of the rock excavator at the head of an 8-foot tunnel of its own making

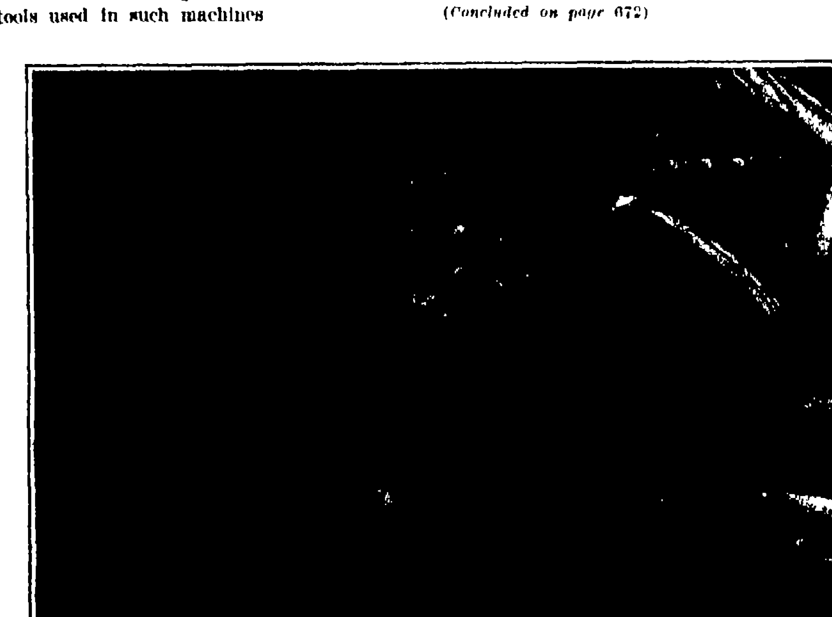
and its life is long; but use the same tool to break or cut the rock by a series of blows with its cutting edge and the steel is soon reduced to a ragged and inefficient instrument. Again, it is highly important that the cutting edge should not be dragged on the rock between blows, for this tends to wear it down rapidly.

The method of the stonecutter is used in the rock excavator developed by Mr. App. Each pneumatic hammer, fitted with 1½ inch cutting tool 6 inches long

(Concluded on page 672)



Rock excavator starting work on a tunnel. The boxlike structure at the rear, used for ballast purposes, has been recently discarded



Rotary head and chipping hammers which cut the face in a series of concentric ridges. Each tool cuts a clearance for the tool preceding it

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns especially when such articles are accompanied by photographs

What the War Has Taught American Industries

SIX months ago the SCIENTIFIC AMERICAN launched a campaign of Industrial "Preparedness for Peace' with the object of warning America against the industrial struggle that will follow the termination of the present European war In pursuance of this campaign we have been publishing articles on our opportunities and how they may be realized, on our wonderful resources and how they may be developed, on our manufactures and how they may be improved, how we may eliminate waste of material and waste of effort

Although the campaign, as such, dates from an announcement in the issue of December 25, 1915, it was really many years before the war that we urged upon manufacturers the necessity of studying their waste heaps and refuse piles for valuable products. We made a special personal study of conditions in Germany and told the American manufacturer of the benefits that accrued to his foreign competitor from the close coöperation with research bureaus However, the war, in the score of months of its duration, has done more to awaken this country than did all our preaching in as many years. Not until we were absolutely confined to our own boundaries did we begin to learn the value of our resources, and how much we had been dependent in the past upon products of the Old World Men who were afraid to try domestic materials for fear they might not measure up to imported materials, and might thus work injury to their finished product and reputation, have now been compelled to rely upon the domestic supply and have found it in most cases equal, and in some, superior to that which has come from abroad

But, best of all in order to find these materials, and to make sure of their quality manufacturers have been forced to go to the research bureau and lay their problems before scientific experts As a result their eyes have been opened to the wonderful detective work that may be done with the test tube and the microscope Secret processes that have been guarded jealously, abroad have yielded to the research of our analysts Products which it had been supposed could only be made in certain parts of Europe we now learn may be made just as well if not better, in America.

The Bureau of Standards, at Washington, is rendering an invaluable service to our country in its present extremity New products are being developed We are finding new uses for our materials, and in taking stock of the resources of this country we have discovered that practically all our needs may be supplied from the natural products within our own boundaries. Our country is so vast that it has not as yet been thoroughly explored It seems probable that even the few products which may now seem to be lacking will in time be discovered

Having experienced the benefits of coöperation with men of science American manufacturers will continue to make use of their services Already they have learned so much that were the war to end to-morrow, our industries would not revert to the condition of absolute dependence upon Europe in which they were held prior to the great conflict But we still have many problems to solve. The SCIENTIFIC AMERICAN will continue to tell the fascinating story of the great awakening of American industries. The story has only just begun

Superstitious America

IF an intelligent Chinaman or Hindu, who had enjoyed the advantages of a modern education, should visit the United States and, on returning home, should write down the results of his observations in this country, he would probably make such statements as the following

"The Americans are a very superstitious people Nearly all of them believe in a great variety of childish signs and omens One notion particularly common among them is that the number thirteen is unlucky. Travelers will refuse to occupy a bedchamber numbered thirteen at a hotel, or a stateroom numbered thirteen on a steamboat, hence thirteen is frequently omitted in numbering such rooms. Highly educated men and women refuse to sit at a table at which the number of guests is thirteen Fortune-tellers, palmists, phrenologists and astrologers flourish in every American city The widespread belief in astrology is especially remarkable in a country where astronomy is more assiduously cultivated than anywhere else in the world My educated countrymen, who have heard of the marvelous scientific achievements of the Yerkes, Lick and Mount Wilson observatories, will probably be astonished to learn that many of the leading American newspapers publish a daily 'horoscope,' supposed to be based upon astrological calculations, and frequently devote long articles to particular astrological prophecies regarding public events. There are also many books published in the United States every year in which astrology is treated quite seriously as a legitimate branch of science."

Alas, too true! Only a few months ago a New York publishing house of the highest standing issued a book on astrology, which was advertised in one of our most dignified literary magazines in the following terms "A book about star influence on human destiny A *powerful* and *stimulating* introduction to astrology *Practical* information about drawing horoscopes" (Our italics) In short, this was by no means a book that anatomized the ancient and picturesque superstition of astromancy from the point of view of the twentieth century, as we anatomize the history of the Olympian gods or the folklore of the Australian aborigines Such books have been written, and they are decidedly valuable In the year 1916 a knowledge of astrology is a useful accomplishment—not as a means of divining the future but as an aid in understanding the past. Much history and a great deal of our finest literature are not fully intelligible without such knowledge Our very language enshrines a multitude of astrological notions and we use such words as "consider' and "disaster' "saturnine" and "jovial," with a finer discrimination for being able to trace them back to the vocabulary of astrology The book in question was, however, not written from the standpoint of the twentieth century, but from that of the middle ages. And it was not published in Peking, or Bagdad, or Seringapatam, but in New York City!

In Portland, Oregon a "college of astrology" has flourished for years Perhaps this explains why so many astrologers are "professors." The fiction that astrology is extinct in civilized countries is kept up by the encyclopædias which in their articles on this "art" almost invariably refer to the practice of it in the past tense Yet of the scores of "medical" almanacs, issued in enormous editions every year in America, there is scarcely one that does not contain the venerable Man of the Signs, or Anatomy of Man's Body, in which the sign of the zodiac responsible for the welfare of each part of the human organism is graphically indicated

It is true, of course, that a great many ridiculous beliefs prevalent among us are only half beliefs. The thirteen superstition, for example, retains its vitality because of the large number of people who find themselves at various stages between the extremes of positive belief and positive disbelief with respect to it. Indeed, there is nothing more difficult than to determine the real attitude of the public mind toward prevalent popular delusions.

One morning last winter, during the sessions of the Pan American Scientific Congress in Washington, a newspaper of that city published, between two columns devoted to the proceedings of the congress, a half-column article recording the ravings of a soothsayer with regard to the future progress of the European war Science and soothsaying bore equally conspicuous headings and were apparently looked upon, from the journalistic angle, as possessing approximately equal news interest. The juxtaposition was striking, but just what interpretation should be placed upon it we are unable to decide.

Human Nature and Election Theory

AT the present day it is difficult for each of us to recall the mental attitude which one possessed before the war A catastrophe of such magnitude affects not only material interests, but causes a curious psychological change in both participants and observers. The change is obviously a permanent one. It is quite incredible that Europe will go back to the same general ideas after the war that characterised it before the war. It was the Napoleonic wars, more than anything else, which destroyed feudalism in Europe. It is interesting to recall some ideas which the war has modified and to see why and in what way they have been modified

Before the war there was an appreciable and growing number of people who honestly thought that a war between any two of the great civilized countries was practically impossible. Many well-known men, at the time this horror suddenly burst upon the world, showed in their writings a kind of indignant astonishment—amazement at the very notion that war was still a possibility, and was about to be an accomplished fact They thought that the mental and moral enlightenment of the masses had gone sufficiently far, particularly in Europe, to form a solid basis of feeling against war which the ruling classes would be unable to overcome. How far they were from the truth we see now, when, after seventeen months of unparalleled slaughter, all the European nations involved are prepared to continue the war with unabated ferocity This complete contradiction of many hopes and some prophecies is instructive. The main assumption which events have shown to be lamentably wrong is the assumption that education can profoundly modify the nature of man. According to the psychologists a man's nature is a combination of inherited psychological predispositions and acquired characteristics. The mob motives which impel men to war must be sought amongst the former class, amongst those fundamental instincts which are modified only very slightly from one generation to another These mob impulses of human nature are not absolutely invariable, it is true, but they change very gradually, and it would seem that all schemes of social reform which presuppose a rapid alteration of these primitive, and, in some circumstances, undesirable traits are foredoomed to failure. It is very important, from the scientific point of view, to recognise these two divisions of human nature. We have an analogous phenomenon in modern physics. It is well known that on the modern election theory the dimensions and mass of a material body change in the direction of the motion of the body, the extent of the change depending on the velocity of the body Well now, this is a very important fact, and yet in all ordinary dynamical calculations we take no notice whatever of this fact. We treat the bodies concerned just as if no change of the kind took place Our justification is that *at the velocities with which we are concerned in ordinary dynamics* the change is experimentally inappreciable. The moral for social reformers is obvious. We grant that man's fundamental nature may change and is changing, but we suggest that for the *periods of time* with which the social reformer is concerned, such changes are inappreciable. Of course, there may be social reformers who are chiefly concerned with what human society will be like a million years hence Our remarks do not apply to them, in this respect their researches are analogous to the researches made on particles moving with velocities approaching that of light, except that in the latter case we know the researches have furnished valuable results, while in the case of the former we may be permitted to doubt. The fact that the fundamental qualities of human nature are practically invariable seems simple enough, and yet not only many Utopias, but many schemes of immediate social reform fail to take that fact sufficiently into account. For those of us who wish war to be abolished from the earth, it would be bad policy to rely upon the extension of education to effect our purpose Actual repressive measures will have to be introduced, and it is difficult to see how this can be done without making the ultimate appeal an appeal to force We cannot alter the nature of man, and the fact that many people now dislike war has probably less to do with education than is generally supposed There have always been people who disliked war, and in the Agamemnon of Æschylus we find exactly the same comments on the senseless waste of war that we find at the present day

The lesson is sufficiently plain. Education, particularly as at present understood, counts for little in this connection. Poetical extracts, the elements of trigonometry, and a knowledge of the lengths of the chief rivers of the world, are powerless materially to modify the instincts transmitted to us by the fighting tribesmen of past ages. A permanent peace for the world is something which can only be obtained by strenuous effort: we cannot trust mankind to drift into it.

Reverting to our analogy with election theory, Schott has shown, in his "Adams Prize Essay," that the election very slowly pulsates. We need not go into details, but he reaches the interesting conclusion that owing to this peculiarity of the election, the catastrophic upheaval of the entire material universe will probably come to pass in a certain number of years. The number is, of course, inconceivably large. It is, at any rate, interesting to find that there are some writers who think that man's nature contains within itself the seeds of its own destruction. The idea is interesting, and does not lack plausibility. The analogy with election theory is obvious. The difference is equally obvious. Man cannot control the pulsations of the election, but he can, though but slightly, control his own nature. Small changes, accumulated over a long period of time, can produce big differences. This does not alter the fact, that, for our present purposes, we must recognise that such changes are indeed small.

Astronomy

Variable Stars Near the South Pole.—According to a Harvard College circular an examination of photographic plates of the region in the neighborhood of the south pole has led to the discovery of 19 new variables, the variation of which ranges from 0.6 magnitude to nearly 4 magnitudes.

Has Venus Ever Been Seen Crescent-shaped With the Naked Eye?—Prof. W. W. Campbell has recently discussed this question, which is raised by a paper in the *Journal* of the Royal Asiatic Society, in which Mr. Joseph Offord quotes cuneiform literature from ancient Mesopotamia containing references to the "horns of Venus." Mr. Offord argues from these references that in the clear air of Mesopotamia the crescent form of the planet was detected in early times without optical aid. Since Venus, when at a sufficient angular distance from the sun not to be lost in the glare of the latter, is hardly more than half a minute of arc in diameter at the utmost, such an observation seems quite out of the question, and Prof. Campbell thinks the allusion to the horns was merely a lucky guess on the part of the ancient astronomers.

Community Observatories.—A happy suggestion looking to a revival of popular interest in astronomy—now apparently at low ebb—is made in a recent article by Dr. Edward F. Bigelow. This writer describes a model "community observatory" which has been built under his direction at Sound Beach, Conn., by means of funds collected from many friends of science, and points out how much more valuable such an institution is in an educational way than the ordinary type of observatory. He suggests that every community ought to have a small observatory for the use of the people, as distinguished from institutions devoted to research. This should take the form of a building with a sliding roof instead of a dome, so that when in use the whole sky would be visible. Several small telescopes would be preferable to one large one. The observatory at Sound Beach cost about $1,300. Dr. Bigelow records the discouraging fact that astronomy has been banished from nearly every high school in the land, and that such outdoor organizations as the Boy Scouts and the Campfire Girls require of their members only an utterly insignificant acquaintance with the stars, such as ability to recognize Polaris and the "Big Dipper."

The Real Forms of Ring Nebulae.—In the course of studies on nebular velocities made at the Lick Observatory during the past three years some evidence has been collected as to the real forms of the apparently ring-shaped planetary nebulæ, which are rather numerous. If these objects are really ring-shaped one would expect a considerable number of them, as seen from our system, to present the appearance of extremely elongated or highly elliptical bodies. None of these have been observed. If, however, instead of being rings these nebulæ are really ellipsoidal in form, then they would present the aspect of relatively broad ellipses from whatever angle they were viewed. The comparatively dark central area completing the illusion of a ring, would be explained if we assume such bodies to be ellipsoidal shells of nebular material, surrounding the central nucleus with a relatively vacuous space between. The measurements of the rotational velocities of planetary nebulæ which are in progress at the Lick Observatory make it possible to draw some conclusions as to their probable masses. Unless their distances from us are much smaller than is supposed the masses of certain nebulæ recently examined must be several times that of the sun.

A Comfortable Observatory for Cold Weather.—A very interesting illustrated article by Russell W. Porter, in *Popular Astronomy* deals with the problem of constructing an observatory in which the astronomer may enjoy a comfortable temperature on cold winter nights. Previous attempts to solve this problem appear to have been limited to refracting telescopes, including the equatorial coudé in Paris, the Hartness turret telescope at Springfield, Vt., the Gerrish polar instrument at Harvard, and the Sheepshanks telescope at Cambridge, England. The author, however, has built adjoining his house a small observing room, above the roof of which he has installed a 16-inch reflector, in conjunction with a siderostat, all the optical parts, except the eyepiece being external to the observing room. The siderostat is driven by a clock and is fitted with setting circles, so that the observer at the eyepiece can bring any part of the heavens within the field of view, except a small region around the north pole, which is cut off by the housing of the mirror. The observer sits in a comfortable chair in a room lighted and heated like the rest of the house. Apart from the loss of light due to the use of the siderostat, the only serious disadvantage of this device appears to be the condensation of moisture on the three mirrors, which on some nights proves very troublesome.

Science

Weather Reports from Light Vessels.—The Lighthouse Service announces that, at the request of the Weather Bureau, arrangements have been made for taking weather observations on the light vessels at Nantucket Shoals, Mass., Diamond Shoal, N. C., Frying Pan Shoal, N. C., and Heald Bank, Texas. The vessels are equipped with radio, and can therefore send in reports for current use when desired.

"Rocky Ford" Melons.—This expression long ago ceased to be limited, in popular parlance, to the product of the pioneer muskmelon district of Rocky Ford, Colorado. A recent food inspection decision of the Department of Agriculture takes cognizance of this fact, and declares that muskmelons of the Rocky Ford type, labeled "Rocky Ford," will not be regarded as misbranded under the Food and Drugs Act if they come from other localities, provided the name of the state or territory where they are produced is stated on the principal label.

Avalanche Warnings.—In the Cascade Range and the Rocky Mountains of the northwestern United States, more or less destruction of life and property is occasioned every winter by avalanches. During the winter of 1909-10, the deaths from this cause amounted to more than a hundred, and several hundred thousand dollars' worth of property was destroyed. During the past winter the district forecaster of the Weather Bureau at Portland, Oregon, Mr. F. A. Beals, inaugurated the practice of issuing special warnings whenever the approach of warm and windy weather, with rain, favors the occurrence of these disasters. The warnings thus far issued have been fully verified.

The Second Pan-American Scientific Congress has issued, from its headquarters in Washington, a substantial volume containing the text of the "final act," adopted at the close of the congress, together with a detailed commentary thereon by Mr. James Brown Scott, reporter general of the congress; also a complete programme of the sectional and plenary sessions, and a list of members and coöperating organizations. The "final act" contains an imposing number of sonorous resolutions and recommendations, some of which may be taken seriously and acted upon, though most will probably share the fate common to *vœux* of this sort. The proceedings of the congress will fill a great many large volumes—but their publication is not yet in sight.

Remarkable Snowstorms in Great Britain.—Strange to say, while the British Rainfall Organization, with its great corps of observers, has for years maintained very thorough observations of precipitation, no systematic attempts have been made by this service to measure snowfall as such; hence it is impossible to furnish comprehensive and authoritative figures regarding the great snowstorms which occurred in England, Wales and southern Scotland last February and March, culminating in a destructive blizzard on March 28th. From the information available, however, it is evident that these storms were quite exceptional, especially in view of their occurrence so late in the season. The storm of the 28th demoralized railway traffic on most of the main lines. In the hill districts of the Peak, the Cotteswolds and Exmoor many villages were snowbound, while sheep were buried beneath gigantic drifts, estimated in some cases as forty feet deep.

Horizontal Rainbows.—When is a rainbow not a rainbow? One answer might be: When it is not produced by drops of rain! On this basis the white rainbow would be excluded because it is produced by fog, and the horizontal rainbow would also be excluded because it is generated by droplets of water spread out in a horizontal sheet and not falling through the air. During the past ten years many such bows have been seen on the surface of Lake Mendota at Madison, Wis., and Mr. Chancey Juday, who describes them in the *Monthly Weather Review* presents a history of previous observations of the same phenomenon in various parts of the world. As seen at Madison the bow, when complete, assumes the form of a parabola, the apex of which coincides with the position of the observer. The outer extremities of the bow—often the only parts visible—consist of bright spots of spectral colors, sometimes repeated once or twice, as in the case of the supernumerary bows of the ordinary rainbow. In some cases fragments of a secondary bow have been seen. The conditions under which these phenomena appear on Lake Mendota are (1) a scum or film on the surface of the lake, which may consist of oily soot or of plankton organisms, (2) minute drops of water deposited on this scum from fog, (3) calm weather, permitting both the formation of the scum and the persistence of the particles of water as individual droplets, and (4) a bright sun. The author quotes an early observation by Clerk Maxwell, in England, of a horizontal bow on the frozen surface of a pond, attributed to the presence of drops of water lying on the ice.

Aeronautics

The Curtiss "Baby" Tractor, which underwent air tests at Newport News recently, is an extremely sturdy appearing machine despite its diminutive size. It has a wing spread of 24 feet and is equipped with a 90-100 horse-power engine. Although of a totally different design the Curtiss "Baby" is reminiscent of the Baby Wright which made its appearance at the Belmont Park Meet in 1910.

Priority of Invention of the Hydro-aeroplane was awarded on June 1 by the District Supreme Court to Albert S. Janin against Glenn H. Curtiss, according to the New York *Times*. A decision of the Commissioner of Patents was reversed on the ground that Janin had established a date of conception three years ahead of Curtiss. The court held, however, that its decision would not take from Curtiss the patentable subject matter he may have originated.

Explosive Bullets are being used in the machine guns carried by Austrian and German aircraft on the eastern front, according to the *Russkoye Slovo*. German prisoners in the hands of the Russians say the order to fire explosive bullets from aeroplanes has been given to all German aviators. If this be true it gives the Teutons a distinct advantage over their adversaries, for one hit scored on the enemy's petrol tank would almost always cause a disastrous explosion.

Observation Balloons of the French.—From a reliable source it is learned that practically all French observation or "kite" balloons are provided with parachutes which may be used by the observers in cases of emergency. Recently some 15 balloons broke away from their moorings during a high wind and drifted toward the German lines. It is reported that the majority of observers succeeded in alighting behind the French lines by the timely use of their parachutes.

A Super-Zeppelin 750 feet long has been seen making trial flights over Lake Constance, according to a report reaching Zurich from Romanshorn, a Swiss town on the lake. The total capacity is believed by observers to be 54,000 cubic meters, or about double that of Zeppelins of the earlier type. The weight of the new craft is estimated at 40 tons, and it is fitted with seven motors, four armored gondolas, machine guns, and bomb and aerial torpedo apparatus. The report is interesting, but is it authentic?

Steam-Driven Aeroplanes.—Not only is the Navy Department engaged in experiments having for their object the application of steam power to aeroplanes, but from reports from various parts of the country it would appear that many private investigators are hard at work on the same problem. Thus far the equipment most favored is some form of flash boiler and a compact steam turbine. Because of the simplicity and high order of dependability of the steam power plants it is not unlikely that in the near future steam will supplant gasoline on heavier-than-air machines.

Predominance of Water-Cooled Engines.—Although previous to the war the leading aeronautical powers of Europe, aside from Germany and Austria, leaned strongly toward the use of air-cooled rotary engines, one of the outstanding features of the air fleets of the Allies is the coming predominance of water-cooled, fixed-cylinder engines. It is frankly admitted that French, English and Italian designers have copied to a greater or less extent the Mercedes engine of the Germans. It is even reported that the French are using a number of Mercedes engines taken from German machines that they have brought down.

Supplying Food by Aeroplane.—Speaking before the House of Commons recently, Harold J. Tennant, Parliamentary Under Secretary for War, disclosed the fact that British aeroplanes had dropped more than 18,000 pounds of food, in addition to mail and military and other stores, into the besieged Kut-el-Amara between April 11 and 29. In spite of the dangers attending the aerial delivery of packages to the beleaguered garrison of the town Mr. Tennant stated that only one British aeroplane was shot down, notwithstanding the Turkish reports that a number of aircraft had been brought down.

How a Machine Gun is Fired through a revolving propeller is told in a recent issue of *Aeronautics*, in an article describing the more important features of two German Fokkers brought down behind the British lines in France. On these monoplanes according to the description, the machine gun is fired through the propeller by means of a small lever actuating a Bowden wire. Provision is further made to throw the machine gun mechanism momentarily out of gear as each whirling propeller blade comes into line with the muzzle. This is done very simply by means of a double cam fixed on the engine shaft and acting on a system of levers. The French Morane, after which the Fokker type has been modeled, also fires its machine gun through the tractor screw.

A frost crack, showing the spruce gum

The Spruce Gum Industry

An Important Article of Commerce from the Northern Woods

By Samuel J. Record

Under cut on a spruce tree, showing the pitch exudation

ONE of the minor industries of the North Woods is the gathering of spruce gum It furnishes regular employment to a hundred men and is casually engaged in by several hundred others It is in Maine that this industry is at its best and there every year some 15,000 tons of crude gum valued at a third of a million dollars, is harvested There are two gum diggers or pickers, of whom the writer has personal knowledge, who bring out of the woods every year a total of 1,000 pounds of lump gum and from six to eight tons of scrape The value of each man's gleanings is between $1,500 and $2 000 a year

Crude gum is formed as the result of injury to red and black spruce trees Hedgehogs feed upon the inner bark of the trees and the injuries they cause, known as "hog cuts," are fruitful sources of gum Lightning scars, frost cracks, old blazes, and the abrasions caused by falling trees, and even sap sucker drills are other occasions for gum formation Around the edges of such wounds little nodules appear and gradually develop into lumps or teats A wide scar heals slowly and may produce gum around the entire wounded area, while a narrow seam closes so quickly that only a single row of these "nuggets" is possible At first these are mere pitch exudations that become sticky when placed in the mouth and are of unpleasant taste It requires at least five years to transform this material into the hard and brittle amber like gum If it remains on the tree too long spruce gum deteriorates and becomes very dark colored

The stimulation of the gum by artificial means is not practiced Very recently, however, some experiments to this end have been started by Mr V C Isola of North Newry, Maine Four different methods have been used, namely, rossing the bark from portions about a foot square near the base of the tree, similar to the work of porcupines, removing a strip of bark 2 inches wide and from 15 to 20 feet long from the south side of a tree to imitate the scar made by another tree in falling, splitting the bark for a vertical distance of 20 feet to give the effect of a frost crack, removing two parallel strips of bark and leaving a two-inch strip between them.

Preceding these experiments study was made of the factors affecting the production of gum It was noted that the sunny side of a tree is more productive than the shady, that trees on exposed ridges yield more than those in cover and on protected slopes, and that the best gumming is usually found in mixed stands of spruce, hemlock and hardwoods, and not in pure spruce stands. An exception to this was found in the case of ledgy slopes where porcupines were numerous. Weather conditions probably play some part, as yet unknown, in the formation and ripening of the gum

Gum gathering is confined to the virgin forests as the yield of cut-over tracts and second growth stands is too meagre to pay A territory once gummed is ready for a second gumming in from five to seven years. The gatherers work alone, in pairs, or sometimes in parties of three or four Working just ahead of logging operations has many advantages in the matter of transportation both of food supplies and of the gum A little log hut near the scene of operations affords better shelter than a tent in cold weather, though the tent has the advantage of being readily moved Gumming and trapping are often combined.

The spruce gummer cleaning gum at the door of his shack

Gathering gum proceeds the year around, though the best time is when the leaves are off the bushes and undergrowth, thus facilitating travel and making the gum easier to "spot" At such times too, the flies are absent or less of a pest Going is best in March when the deep snow covering the underbrush is crusted over The gum in cold weather is extremely brittle and often flies into fragments when touched with the ax or gathering tool These would be lost in soft snow, but are easily recovered from the crust. Walking in the deep snow the picker is able to find and reach many choice bits of gum which otherwise might pass unnoticed.

Not all of the gum is high up in the tree In fact a great deal of it occurs near the base and considerable quantities are picked up from the ground where it had fallen after being broken off by the swaying of the tree in the wind, by frost action, or other means. During the snow season this part of the crop is inaccessible.

In gathering the gum the men work systematically in strips three to four rods wide. Where the gum is within easy reach the gatherer holds a bag or his hat under it and chips it off with a small ax For higher up the tree he may build a staging, climb the tree, or in exceptional cases cut the tree down. Some operators use a special gathering tool, a chisel (usually made from an old file) inserted in the end of a pole and a tin receptacle fastened just beneath the chisel. The other end of the handle is hollowed out so that a stick can be fitted into it for extension. This enables the collecting of lumps far out of reach otherwise, though so much breakage of the gum results that many professionals will not use such tools.

Work in the woods begins at daybreak and is usually concluded by 3 P M. Upon returning to camp the collector goes over the contents of his back pack and sorts and cleans it. Rainy days may also be devoted to this purpose So far as possible all bark and other foreign material is removed and the lump gum is put away carefully in a cool, safe place In warm weather the lumps are put in a bag and sunk in a brook or spring to prevent the pieces sticking together The scrapings and crumbs are stored in a barrel.

The yield of a day's work varies considerably. Some pickers consider 25 to 30 pounds a fair day's toll while others claim to average as high as 40 pounds, and sometimes make 60 pounds Getting the chip gum out of the woods is quite a task, particularly when far from logging operations. In winter it is often loaded on a hand sled or toboggan and drawn out by hand.

Crude spruce gum is divided into two principal grades, lump and chip. Lump gum, as the name implies, comprises the nuggets or "tits" as they are known in the vernacular of the trade. This material may be separated into three grades based largely upon color and weight, which are mainly matters of age. First grade is light in weight, porous, and about the color of good honey It is quite free from moss, bark and other impurities when gathered The wholesale price for this grade is quite stable at from $2 25 to $2 50 a pound Second grade is reddish or wine-colored and is not so porous as first grade, though for chewing purposes it may be fully as good or better The difference in color and consistency is due to this gum being a little older Third grade is a catch all for lump gum that will not go into the first two grades. It is old gum that has usually begun to deteriorate and varies widely in color, being often quite dark It sells for about $1 50 a pound wholesale It is sometimes put up in small half-ounce pasteboard boxes which retail for five cents each

Chip gum contains the scrape from wounds on the tree, and the crumbs and fine particles resulting from cleaning lump gum This material is so full of foreign matter that it has to be refined before going on the market. It is first washed in three or four changes of water and the free bits of spruce bark, fine moss, and dirt rise to the surface Some of the bitter pitch is also gotten rid of in this manner

The next step in the handling of this low grade gum is to steam it. The steaming apparatus consists of a wooden box 4 feet square and 1 foot deep, fitted over a large funnel 4 feet square at the top and tapering to a narrow neck at the bottom Between the

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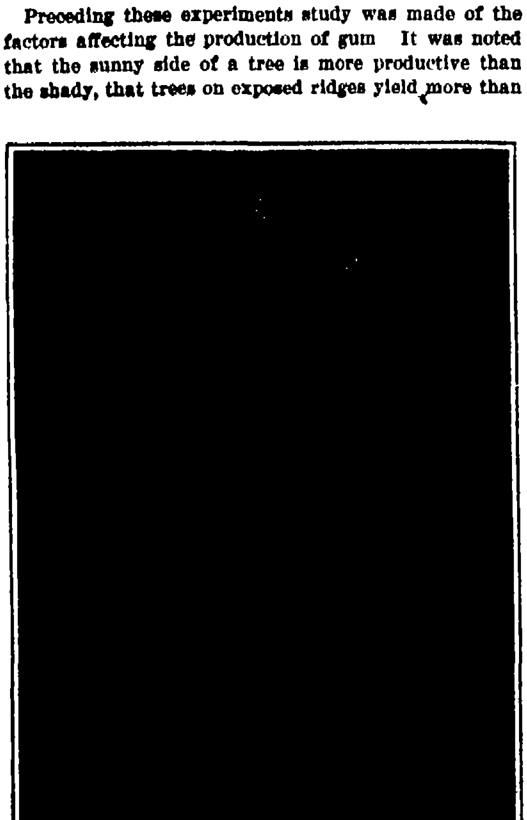
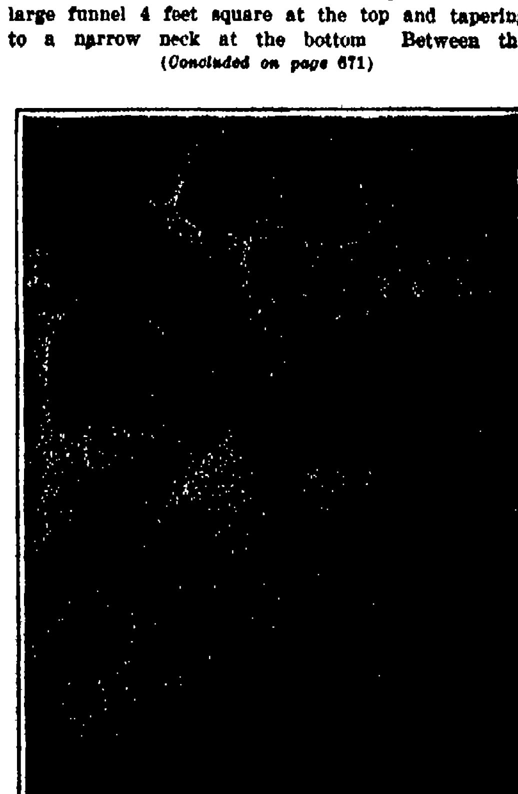


A spruce gummer busy at his daily task



Spruce gum nuggets and a piece of steamed gum in stick form

Railroad Fire-Fighting Apparatus Used in Canada

ALTHOUGH it seems almost incredible to say so, it is nevertheless the truth that the railroads of this country are powerless to combat their own fires with effective fire-fighting apparatus. The underwriter's list shows a huge loss annually to the railroads where fires occurred in sections removed from city fire protection. If the city firemen can not respond or the city fireboats can not help fight the fire, the railroad sits idly by and waits until the blaze dies out.

Not a day goes by but what one reads in newspaper accounts of fires where engines pulled away freight cars from the danger zone. But one never reads of engines helping extinguish a blaze. There is no such thing as a fire-fighting locomotive, nor a fire-fighting railroad car—that is, if one excludes the apparatus which forms the basis for this article. From the standpoint of efficiency and preparedness our railroads might be classed with the extreme pacifists of peace at any price.

When it became evident last year to the directors of the Transcontinental Railway of Canada that something had to be done, and done quick, too, in regard to the loss along the right of way by fires, an order for a fire-fighting car was turned over to the Canadian Government Railways' Shops at Moncton, New Brunswick. Shortly thereafter an apparatus consisting of a large water tank of more than 10,000 gallons capacity, mounted on a flat car in order that it may be transferred to any point on the system where fire may be threatening, was put in operation. It has already paid for itself many times over, although it is perhaps the only car of its kind in existence.

Mounted on the tank is a steam driven pump having a capacity of 800 gallons a minute. This pump is supplied with all necessary hose, nozzles and other fittings. The steam supply for operating it is taken from the car heater of the locomotive to which the car may be attached, and by setting the car heater regulator of the locomotive at a pressure of 125 pounds to the square inch a water pressure of about 100 pounds is obtained at the nozzle tip.

Before the Transcontinental Railway accepted the apparatus it was tested and found to be capable of throwing two one-inch streams of water a distance of about 200 feet to either side of the track. Two or three men can operate the nozzles and one man the pump, although two men in an emergency can work the apparatus to its full capacity. American railroad men are watching the car with interest. It will not be long before our railroads will have an efficient fire-fighting equipment of their own, if the fire car in Canada proves successful.

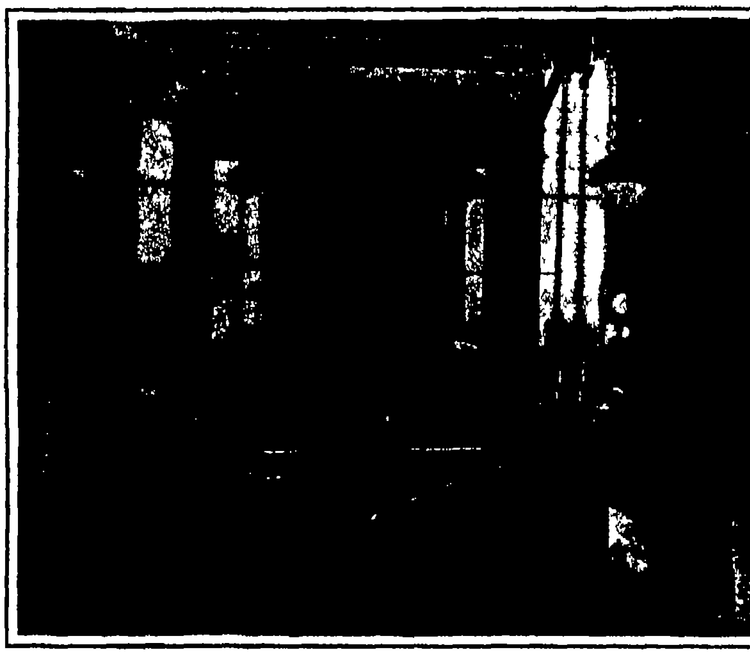
Fire-fighting car employed the Canadian railroads. It consists of a 10,000 gallon tank, a steam pump, and the necessary hose

Applying Truck Tires With a Press

THE accompanying illustration shows how one company re-tires truck wheels in a minimum of time, saving expense and loss of time to the firm that needs every truck to maintain its prompt service delivery.

The wheel needing a new tire is placed in a hydraulic press. With steel cylinders acting as buffers, the old tire is pressed off under 100 tons pressure, to be rebuilt or discarded. A steel band for the felloe, if such is needed, is taken care of by appliances on hand. A band heater, fed with natural gas, prepares it for the wheel and cold water quickly shrinks it immovably into place. Replaced on the hydraulic press, the wheel receives its new tire under necessary pressure, steel cylinders again acting as buffers. The entire operation requires but a comparatively short time.

In the accompanying illustration is shown how dual solid tires are forced into position on a truck wheel, in a few moments' time.



A typical hydraulic press in the act of pressing dual solid tires into position on a motor-truck wheel

Supplying Fresh Air Through Canvas Tubes to Underground Workers

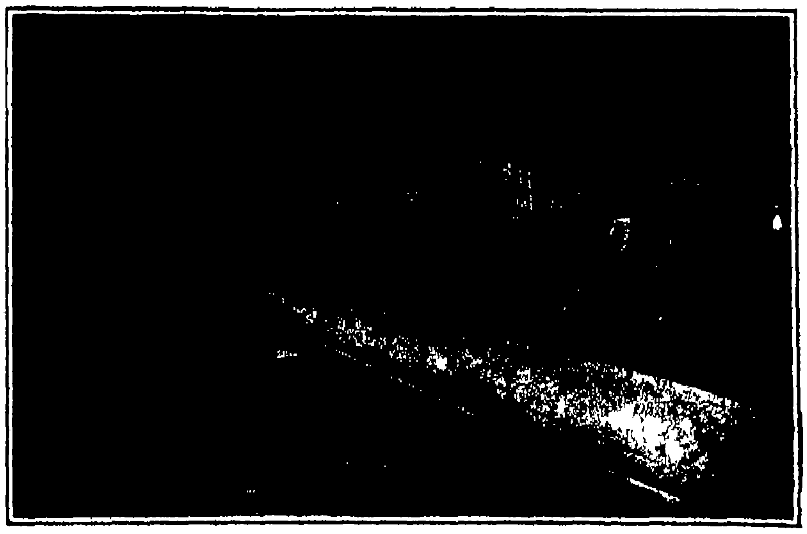
THERE is a two-fold reason for supplying an abundance of fresh, pure air to miners and other underground workers: first, it is of vital importance to the health of the workers; second, the removal of inflammable gases, particularly in coal mining. In tunneling and similar subterranean work a circulation of air must be constantly maintained, for gas, foul air, explosion dust and powder fumes retard labor, cause inefficiency in the work and result in additional expense to the contractor.

A manufacturer of canvas bags recently had brought to his attention the difficulties and inconvenience accompanying the use of a tin duct in the ventilation of underground workings. He was not slow to act on the suggestion that suitable duct might be made of canvas tubing, and in a short time he succeeded in evolving specially treated canvas duct that has met with great favor since its introduction.

The advantages of the new form of tubing are numerous. In the first place, it is not necessary to have a smooth or level floor as with tin or wood tubing, for the canvas is just sufficiently pliable to adapt itself to any position in which it is placed. It is much lighter than either the tin or wood duct, and can be carried back from the face of the tunnel by one or two men preparatory to blasting, and dropped along the side. This operation can be done in a few minutes' time, whereas with a tin duct each joint would have to be disconnected and carried back and the operation repeated after the blast was made, obviously consuming considerable time. If a hole is punched in the tubing it can be easily patched or a section of any length desired can be inserted in a few minutes. With fans of suitable capacity, it is possible to deliver air for distances varying from 500 to 600 feet with ease. When the fans are not working the tubing collapses and can be hung on or pushed against, the side of the tunnel. When the fans are started the tubing fills out and remains so as if it were reinforced with a spiral of steel wire.

It is particularly in the ventilation of mines without cross-cuts that the canvas tubing is attracting much attention. Heretofore it has been the practice to force a great volume of air through the shafts and entries of a mine, dividing or splitting the current at different points in its course so as to carry it to every part of the mine. Usually the galleries or tunnels are driven in pairs and at frequent intervals connecting tunnels or cross-cuts are driven between them so as better to circulate the flow of air. As the work in each gallery progresses and the face advances farther and farther the cross-cuts in the rear are closed or sealed up in various ways in order that the air current will not find a ready by-path and thus fail to reach the head of each gallery in any appreciable volume. By means of the canvas duct it is believed that successful ventilation of mines can be carried on without the use of frequent cross-cuts.

Canvas air duct in a mine, at the point where it connects with a metal tube leading to the fan



Installation of a canvas air duct in a mine. Note how it adapts itself to floor irregularities

Strategic Moves of the War, June 15th, 1916

By Our Military Expert

THE timely and powerful Russian offensive has achieved immediate results in addition to the large local territorial gains secured, by the lessening of the Austrian assaults which a few days ago seriously threatened the Italian line guarding the Venetian province. Already the Italian troops have been able to press forward for the double purpose of regaining lost ground and holding their former assailants in position in their immediate front, to prevent detachment of troops to the eastern line.

Reports at the moment these lines are written indicate that the Russian offensive has extended north of the Pinsk topographical features which practically divide the eastern line into two grand sections. To the northward of Baranovichi seven powerful thrusts have been made by the Czar. At the moment it seems likely that this attack was merely for the purpose of preventing detachment of German troops to reinforce their hard pressed Austrian allies in Volhynia, Galicia and Bukovina although after the tremendous surprise of the Russian general attack—which surprised the Austrians most of all—it is by no means impossible that Russian forces have gathered in sufficient strength to extend their determined activities even farther north of Pinsk than the 75 mile point where Hindenburg was attacked. The Germans previously attempted counter movements on the Riga-Jacobstadt-Dvinsk front to create a diversion in favor of the southern portion of the line but according to the dispatches they made little or no impression on the Russian front. These small counter offensives are so obviously called for as relief measures that it may be taken for granted that they were expected and, further, that adequate provision had been made by the Russians to meet them. As on numerous former occasions the Austrians have been compelled to call upon Germany for immediate and unstinted aid. Hitherto it has been forthcoming with definite results. In this case the response remains to be seen. The dispositions of the German general staff are so invariably excellent that if no strong development ensues in answer to the call it may furnish a very real confirmation of reported lack of reserves, and of unreplaceable losses which have been sustained on the fields of Verdun.

In the Russian offensive the principal massing of troops appears to have taken place before the Volhynian triangle of fortresses as well as to the south of Tarnopol, in Galicia and Bukovina. The Austrians are holding directly to westward of Tarnopol but the powerful thrusts to either side threaten to force evacuation of the salient thereby formed and at no distant date. As matters now stand however the salient is on the other side, and it is reported that strong Teutonic forces have massed between the northern face of the Russian salient and the Pripet. A successful downward thrust on the part of the Germans would almost certainly upset the Russian communications, not only effectively checking the offensive, but in all probability breaking the Russian line definitely. But it is seriously to be doubted whether sufficient Teutonic reserves are available to force such a breach or carry it through if a local break of any respectable dimension should occur.

The Russian attack has for its ultimate object of course the thrusting back of Teutonia from the Czar's domains and the winning of a victory which would decide the war. But there are first local objectives to be gained and these seem to be about as follows:

Kovel. The Russians are now about 22 miles south east of this most important railway junction, where five roads meet and there has been no report of check in their forward movement for several days. The loss of this point would seriously handicap the Austrians flank their line north and south and the menace to the more important Brest-Litovsk farther to the northwest would become immediate.

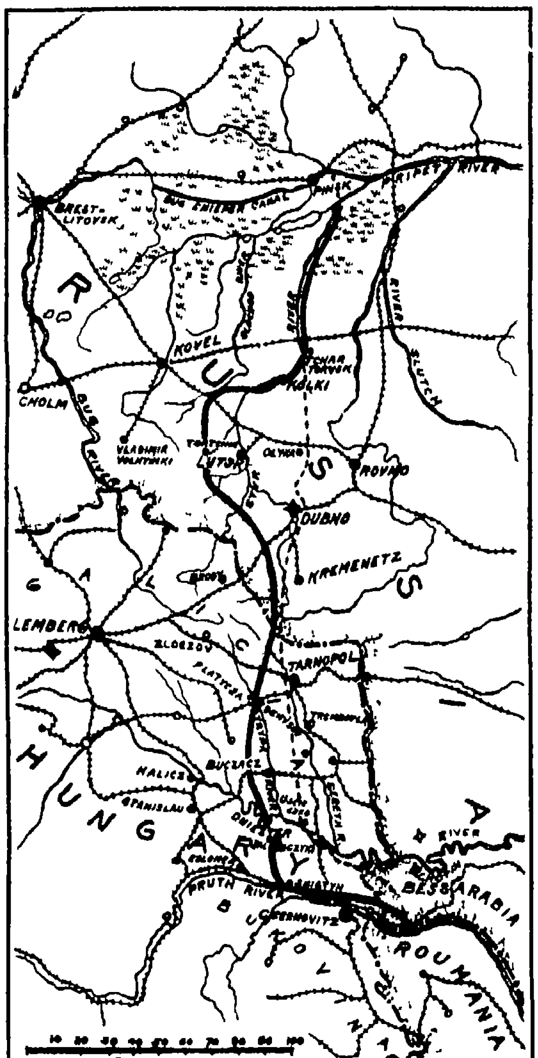
Lemberg. Eight railways center here and its importance is obvious.

Halicz. A minor junction, but one closely connected with a second junction not over 15 miles to the south ward, possession of either would almost accomplish possession of the other and at once imperil the communications of—

Kolomea. This junction is of paramount importance for the establishment of an advanced base for operations against the Carpathian passes. It lies about 65 miles west by north of Czernovitz.

It seems generally to be expected that the success or failure of the Russian enterprise will be indicated within the next few days. Military observers are looking for a movement from Saloniki where General Sarrail commands between 500,000 and 600,000 men, directly on the flank of the Teutonic-Turkish communications with little beside the army of Bulgaria before them. If Roumania is persuaded by Russian success to attempt the hoeing of her own row, little short of a miracle could prevent the crushing of Bulgarian aspirations and the definite severance of Turkey from the Central Empires, with the Grand Duke battering at the back door of the Ottoman territory.

The English on the western line appear on the verge of inaugurating movements of moment, while the French give every indication of determination that Germany shall not be allowed to break off the battle of Verdun. Perhaps the international military conferences of the Entente have borne sufficient fruit to guarantee that no element of the alliance will again be required or permitted to sustain an offensive alone. Such concerted action however, has not as yet developed, although there is ample indication of imminency.



The battle front south of Pinsk

Former front shown by broken line. Russian positions on June 15th shown by bold line

At this date the position of the Russian line south of the Pripet marshes is about as follows:

The difficult country immediately south of the marshes in conjunction with strengthened Teutonic forces has not as yet become the scene of Russian gains. This inactivity, however, constitutes a factor of safety to Russian as well as to Teuton, for movements are difficult for an attacker and passive defense is comparatively easy. The ground therefore establishes a reasonably safe rest for the right flank of the attacking Russian line which extends to southward.

Almost west of Kolki the Russians have gained ground past the Styr to the Stokhod River, about 20 miles from Kovel, the line appearing to run almost west from Kolki to Boguchovka, on the Stokhod. From this point the line runs southward to Tortchin, which is about 15 miles west of Lutsk. It is on the Sierva River and within 45 miles of Vladimir Volhynski, a rail head on an affluent of the Bug, which is but a few miles west of it. From here the line seems to sway eastward to a point from 10 to 15 miles west of Dubno, gradually straightening out further to the southeast, a few miles west of Kremenetz.

West of Tarnopol there is little change. The Austrians, reinforced by German troops, have made a desperate stand, and the Russians have been unable to gain much ground at the present writing.

To the southwest of Tarnopol the Russian line sags forward again, having reached a point to westward of the Zlotalipa River. Buczacz has fallen, and the Russians are pressing forward along the railway toward Halicz.

Zaleszczyki has been passed and a considerable section of the Dniester has been lost to the Austrians. The Russian line now reaches Sniatyn, almost directly to the southward. This point is about 20 miles north west of Czernovitz, and its occupancy has automatically cut the railway leading northward from Czernovitz. The Russian line is also within easy artillery range of the railway to Kolomea. For all practical purposes communications along this line have been severed by the Russians, and evacuation of Czernovitz seems but a matter of hours. There is, however, ample means of egress from Czernovitz to the southward, as a railway extends to the not-distant Carpathians and their passes.

Should the Russian offensive through Galicia prove successful and any material distance be gained, as, for instance, should Lemberg and Przemysl be reached, it would establish a situation new in the great war. When Russia previously held these important places the Germanic armies were well to the northwest, with their communications absolutely safe from menace. But with the Germans in their present position north of Pinsk to Riga, Russian occupation of Przemysl and Lublin would rip the very lining out of security and form one side of a most promising bag in which the entire German force might be inclosed. There is little likelihood of any such development, however, for if the Russian movement shows signs of making any such vast territorial gains the German line will undoubtedly retire and that hastily. Valor has nothing to do with it. It would be discretion of the most ordinary sort and dictated by direst necessity.

The most interesting aspect of the Russian offensive after the surprise of Russia's powerful "comeback," is that of wondering how her allies are going to back her up. Will they coöperate in full and give her every chance to beat her way through? Or will some unknown factor of warfare require them to wait longer before sailing in with every ounce of energy? Those forces at Saloniki draw the attention of an observer like an arc light in a dark street. Surely the time is almost here when the *raison d'etre* of their concentration will be demonstrated.

And an equally interesting subject of speculation is "What is the Kaiser's staff going to do about it?"

The Current Supplement

THE issue of the SCIENTIFIC AMERICAN SUPPLEMENT of June 24th, No. 2112, completes the volume including the first six months of the year, and contains an *Index* covering that period. It will be valuable to preserve for convenient reference. *The Fallacy of the Nebular Hypothesis* reviews an important subject, and gives a concise history of the various theories that have been brought forward regarding the motions of the heavenly bodies, together with reasons for discarding them. The fifth, and final article of the series on *Economy in Study* appears in this issue, and should not be missed by anyone who has read the previous interesting papers. *The Making of Military Roads* tells something of the extensive work necessary for the efficiency of a modern army in the field, and there are a number of illustrations. A timely article is the one on *Liquid Fire* which treats of one of the novel weapons brought forth by the war. A number of sketches illustrate the description. *The Purification of Water Supplies* is a subject of vital importance to every, man, woman and child, especially in these days when theorists and politicians so generally control the character of this necessary article. *Making Roads and Men* tells of methods of using convict labor in some western states for building roads that not only are of material benefit to the state, but are especially successful in redeeming and reforming the convicts, thus resulting in a double gain to the community. *A Lecture Room Oscillograph* describes the details of construction of an instrument that is required in every well-equipped physical laboratory. Excellent detail drawings make the construction perfectly clear. *A Marine Disaster on the Coast of China* tells of the wrecking of a big modern steamship, and is accompanied by two striking photographs. *Modern Air* gives many interesting facts relating to the air we breathe with relation to health, and explains popular theories. *Capillarity and Soap films* gives a summary of a discussion by Prof. Dewar on problems in capillarity. Other articles of value are *The War Zeppelin* and *The Reform of the Man of Science*.

Correspondence

[*The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.*]

The Binding of Books

To the Editor of the SCIENTIFIC AMERICAN:

The SCIENTIFIC AMERICAN'S object is in part "to reflect the most advanced thought in *science and industry throughout the world*."

In regard to the above statement I would like to see some good sense reflected in the way that books and pamphlets, in my humble opinion, ought to be bound. To be sure books have been bound for hundreds of years and many, no doubt, think that they have arrived at perfection. But they are a long way from it.

I had a brother in law, in Germany, who was in that business for more than 60 years. All his books were always bound so that wherever you opened the book, it would always stay, but the majority of the books bound in these days of commercialism are bound so that you almost have to put it in a vice to keep it open.

There is no comfort in reading such a book because your attention is continually diverted from the subject matter and directed to the mechanical part of squeezing the leaves apart. This is not all, but I believe that a great many books are ruined in precisely that way. It is true I might bring this matter before the book binders associations, but they would most likely only laugh at it and say they 'know better' and "that is the way we have learned the trade" and "we always bound books in that way," etc.

Another thing ought to be abolished, namely the wire binding of pamphlets, etc. In a short time, particularly in damp weather the wires get rusty and the leaves not seldom literally rot off. When I get a book or pamphlet wire-bound, I immediately take out the wire and stick the leaves together with needle and thread. To be sure that is work and takes time, but it pays with the comfort you get out of it.

Of course, the SCIENTIFIC AMERICAN is not specially charged with helping the bookbinders, but as the SCIENTIFIC AMERICAN is to reflect the most advanced thought in science and industry throughout the world, I thing it will be very appropriate to give the millions of readers a hint about making some little but very timely improvement.

DR. J. MÜLLER.

Chicago, Ill.

The Dye Industry as a Factor of National Security

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial on page 574, Industrial Number, June 3rd, 1916, "The Dye Industry as a Factor of National Security," is the very best combination of words to cover *Preparedness* that I have had the chance to read.

That small section in italics, "a dye factory may be changed within a week into a factory for the production of high explosives," ought to be in *black letters* about half an inch high.

If that piece isn't copied by newspapers broadcast, I'll think the searchers after the right matter are petering on their job.

There is another section which ought to come in good and hard—*big letters*—I mean—the safeguarding of the new dye concerns by our Congress.

Can't you say the same things again, before long? Maybe you will have to change it a bit so that it will look newer, but if it can be put before the eyes of the SCIENTIFIC AMERICAN'S readers again and again, it will accomplish a great deal of good.

It's a corker.

CHARLES FRENCH PERRY.

Bangor, Maine.

The Coudersport Freezing Cave

To the Editor of the SCIENTIFIC AMERICAN:

At Coudersport, Pennsylvania, there is what seems to be a natural rock cavern which apparently is the largest freezing cave yet discovered in the eastern United States. Occasionally notices about it appear in newspapers, and they usually speak of it as do the natives, as an ice mine and repeat in various ways the statements and theories which the peasants of France, Germany, Switzerland, Austria and Italy have advanced about freezing caves for some two hundred years. An article in the SCIENTIFIC AMERICAN of May 6, entitled "An Ice Mine That Freezes in Summer and Melts in Winter," says of the Coudersport freezing cave that geologists are not able to explain "why the ice should form, in seeming opposition to the laws of nature, in summer and melt in winter, as it does in this instance."

Subterranean ice, however, is not an uncommon phenomenon. Several hundred instances of it are known, and the causes of its formation have been studied with the utmost care by numerous scientists. Very briefly, the gist of their many observations is as follows: Subterranean ice is formed only in localities where ice forms in the open in the winter time. Two factors are necessary for the formation of ice: cold and water. For ice underground the cold of winter furnishes the first, the thaws of spring furnish the second. In all known cases the body and main side passages of the rock hollow are below its mouth and into these the heavy cold air of winter sinks by gravity. When, then, the spring thaws occur, the water runs into the cave and freezes. More slowly the light hot air of summer in turn permeates the cave, and as it does it melts the ice.

A series of weekly or even monthly, observations made for a year at Coudersport by a competent observer—and surely there is some school teacher or physician at Coudersport who is competent—would show doubtless that the ice formation there obeys the same natural laws which subterranean ice formations in other parts of the world obey. Such a series of observations was made, for instance, about the freezing cave at Decorah, Iowa, by Mr. A. F. Kovarik and his results were published in the SCIENTIFIC AMERICAN SUPPLEMENT, November 26, 1898. Until this is done at Coudersport, all sorts of erroneous notions will be peddled about by visitors as well as by natives and a well understood natural phenomenon will continue to be spoken of, with bated breath, as a mysterious, unique marvel.

EDWIN SWIFT BALCH.

Philadelphia, Pa.

New Ways of Using Wood Waste

To the Editor of the SCIENTIFIC AMERICAN:

The statement by J. Gordon Dorrance in the article on *Wood Waste* at page 427 in the SCIENTIFIC AMERICAN of April 22nd, 1916, is an instance of careless writing. The "New England paper manufacturer" does not develop a lard substitute from "pulp wood waste." This would be impossible. What he does is to utilize the hydrogen evolved in electrolytic bleach work for the hydrogenation of oils. It is a side industry. The same paper manufacturer utilizes an excess production of chlorine for making chloroform, the daily production of which is 2,000 pounds, but this is not a "by product from this pulp wood waste" any more than the lard substitute is.

T. J. KEENAN.

New York City.

How Celluloid May be Manipulated

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of February 26th appears the article "Celluloid Covers for the Laboratory." I have used celluloid sheet for a variety of purposes where lightness, compactness and transparency were desirable features. Sharp bends may be produced with relative ease by applying a hot iron or other device to the line of the angle. Joints I have and frequently make now with acetone. The two overlapping pieces are held together, acetone is applied from a dropper so as to flow between the surfaces and these are then pressed firmly together. Adhesion results very quickly so that usually no mechanical holding device is necessary. Irregular bends, especially at junction points, can likewise be made by allowing sufficient acetone to be absorbed by the one part so that it becomes plastic and can be molded into contact with the other part by pressure of the fingers. In this way a dustproof cover can be produced having also more rigidity when completely dry than the one described in your article.

Collodion sheets obtained by cleaning spoiled negative films is very useful and handy for many purposes and can easily be manipulated and joined by aid of acetone.

HERMAN S. RIEDERER.

Baltimore, Md.

Engineering Maxima in the United States

[*Some foreigners seem to hold the opinion that the greatness of this country lies in the extremes to which we go. This may or may not be a compliment to us, though the foreigner seems to think it is. An American engineer received a request recently from a friend abroad to send him data concerning a number of the extremes which have been reached in this country in engineering structures, and in return for some assistance rendered by the Editor of the* SCIENTIFIC AMERICAN *in making this compilation, the compiler has sent us the data for publication. As such maxima are of some interest we suggest that if any readers know of any of them having been exceeded we will be pleased to publish such revisions from time to time. The data refer to this country only, though including our neighbor Canada.*—EDITOR.]

Railroad Bridges. The longest span is the cantilever bridge over the St. Lawrence River, near Quebec. The spans are 515—1,800—515 feet. It contains 63,000 tons of steel. The next largest single span, but the longest if the bridge approaches are included, is the one over Hell Gate, New York City, the total length with approaches (some of which are stone arches) is 18,130 feet and it contains 87,000 tons of steel. The longest single span is 1,000 feet. The longest single structure steel bridge is probably the one at Kansas City, which is 1¾ miles long.

Steam Locomotive. The largest and most powerful steam freight locomotive ever constructed is the articulated Erie Triplex built by the Baldwin Locomotive Works. It has 12 pairs of driving wheels, four of which are under the tender, besides two-wheel leading and trailing trucks. The total wheel base is 90 feet and it weighs with the engine and tender in working order 853,050 pounds or about 426.5 short tons. It has a tractive force of 160,000 pounds when working compound. The tender has a water capacity of 10,000 gallons and a coal capacity of 16 tons.

Electric Locomotive. The largest electric passenger locomotives are those operated on the Chicago, Milwaukee & St. Paul Railway developing 3,440 horse power each or 3,000 continuously, measuring 112 feet 8 inches overall, and having a tractive force of 800 tons over all grades up to 2 per cent. On a level track they will also haul the same tonnage at a speed of 60 miles per hour. The largest electric freight locomotives of the same railroad have a capacity to haul 3,000 tons up a 1 per cent grade at 15.5 miles per hour, or the same load on a level track at about 30 miles per hour. The largest freight locomotives on the Norfolk & Western line are the single phase three-phase, consisting of two sections, weighing together 540,000 pounds and having a motor capacity of 2,400 horse-power and a tractive force of about 135,000 pounds at 14 miles per hour.

Trains. The longest freight trains in regular use are believed to be those on the Erie Railroad, consisting of 80 to 90 cars weighing about 70 tons each; the total length is about 3,400 feet, or about two thirds of a mile. A test train of 251 loaded cars of a total weight of 17,912 short tons back of the tender and a length of 8,547 feet or about 1.6 miles, was pulled by this locomotive, but this is not regular practice.

The longest passenger train run occasionally in commercial service on the Pennsylvania Railroad has 16 cars of 60 tons each, and a locomotive weighing 200 tons. The longest one run regularly has 12 cars. The longest freight train on that road has 125 cars of 70 tons each when loaded and a locomotive of 220 tons.

Central Stations. Among the largest are that of the Commonwealth Edison Co., Chicago, approximately 310,000 kv.a. generated by steam. The two New York Edison stations approximating 280,000 kv.a., also steam driven. The Mississippi River Power Co. has at present 135,000 kv.a. installed with an ultimate capacity of 270,000 kv.a., generated by water power. The Philadelphia Electric Co. has approximately 162,000 kv.a. installed, all generated by steam. The Niagara Falls Power Co. operates 67,000 kilowatts in three different plants. These central stations are not always entirely under the same roof, but when under separate roofs they are interconnected electrically forming one system. Of these the largest one furnishing city service is the Commonwealth Edison Co., with the New York stations next and the Philadelphia stations probably third.

Electric Transmission. The longest distance is 275 miles at 150,000 volts (nominal) on the system of the Pacific Light & Power Co. in California.

Voltage. The highest voltage used in transmission is 150,000 volts nominal (actually 148,000) on the Y connected transformers of the Pacific Light & Power Co. in California.

Generator. The largest single electric generator is 47,000 kv.a. which is to be installed in the near future at the Duquesne Light Company's plant in Pittsburgh. The largest now installed is the 35,000 kv.a. unit at the Philadelphia Electric Company's plant.

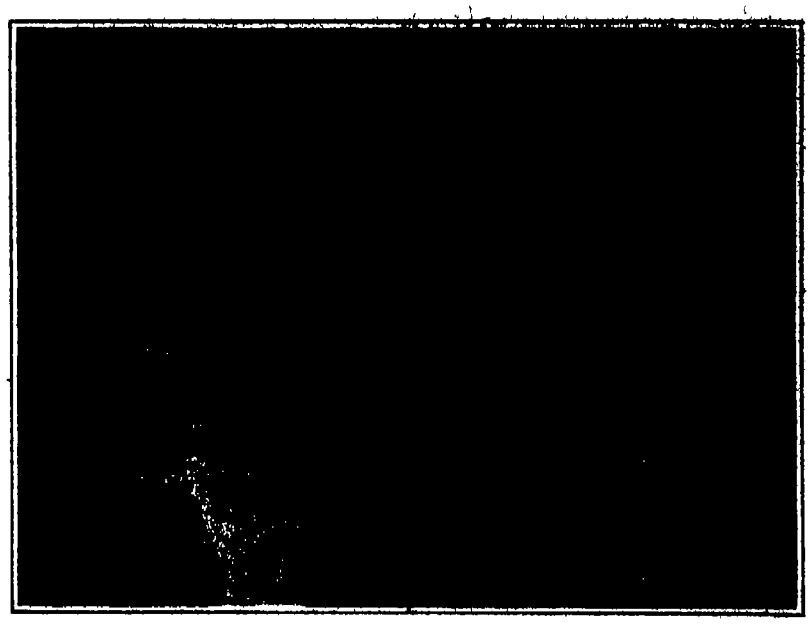
Arc Lamps. The largest in regular use for lighting is a flaming arc of 12.5 amperes, 110 volts and for flood lighting as high as 100 amperes at 110 volts. For photographic purposes as high as 30 amperes at 110 volts. For etching glass 95 to 150 amperes at 110 volts. For searchlights 200 amperes.

Incandescent Lamps. The largest made commercially is a 2,500 watt lamp. Larger ones of possibly 4,000 to 5,000 watts have been made but not commercially.

Telephony. The longest distance to which telephony over wires has been carried out is from New York to San Francisco by way of Boston, Buffalo, Chicago, Denver, Salt Lake City and Portland (Oregon), a total length of circuit of over 4,700 miles. About ten telephone relay or repeater stations were used.

Buildings. The highest office building in the world is the Woolworth Building in New York City, which is 750 feet high to the observation platform, the lantern being 42 feet higher. The largest in area is the Equitable Building in New York City, having a total floor space of 1,200,000 square feet, nearly one twentieth of a square mile, or nearly 27 acres.

Soldiers' hospital car, showing the arrangement of the combination stretcher-beds



Officers' hospital car, provided with white enameled iron beds and adjustable tables

A Model Hospital Train

Describing the Completeness of the Bavarian State Hospital Train

By Alfred Gradenwitz

SOME time ago the German Museum of Munich decided to place at the disposal of the King of Bavaria a considerable sum destined for the benefit of the wounded The king ordered this contribution to be used for the equipment of a State Hospital Train, which was eventually attached to the Sixth German Army and placed under the orders of Crown Prince Rupert of Bavaria

The task of the Museum consisted in availing itself of all the resources of science and engineering with a view to insuring as hygienical and comfortable transport conditions as possible The Museum was eminently fitted to fulfill this task in so far as it had a number of the foremost experts at its disposal and because of its unparalleled connections with German industry, which greatly facilitated the obtaining of model arrangements in every respect

The State Hospital Train is designed for transporting about 200 patients, and for accommodating in addition the personnel, which comprises 3 doctors 3 managing officials, 2 clergymen, 3 female and 22 male nurses, 3 stokers and engineers, 2 male cooks, 4 soldiers and 3 railroad officials, a total of 45 persons.

Twenty nine cars are provided for transporting and feeding the wounded and sick, as well as the personnel, viz., 14 soldiers' hospital cars, each comprising 14 berths, one officers' hospital car, comprising 7 berths, 1 operation and X ray car, one disinfection car, one lighting car, 2 cars for doctors, female nurses and clergymen, 2 cars each for 10 male nurses, 1 manager's car, one kitchen car, one kitchen provision car, one linen storage car, and 3 baggage and materials cars.

Considering first the soldiers' hospital cars, these are found to be extra spacious, three-axle railroad cars each comprising 14 berths, arranged on the two sides. These berths in reality are stretchers designed to be placed by pairs, one above the other in spring-supported frames The upper stretcher, whenever desired, may be pulled upwards by day or hinged backwards, the lower stretcher then constituting a comfortable couch with its five-sectioned mattresses and bolsters For the additional comfort of those seriously wounded, the upper stretcher may be removed and the mattresses of the upper berth used for the lower berth, so as to place the patient on double bedding and at a convenient height for the doctor

Each berth of the soldiers' hospital car includes a little table, which is designed to be used both as a dining table and reading desk Above each berth there is provided a string for the patient to raise himself by, while on one side there is a little case in which he may store his valuables and the like Each hospital car for soldiers contains a washstand chest provided with drawers and a hinged lid, which may be used as a desk when so desired Wearing apparel of patients is kept in a spacious cupboard A lavatory and washstand complete the equipment

In the officers' hospital car there are installed 7 separate beds made of white enameled iron pipe, which are spring supported so as to damp any shocks and jerks incidental to railroad travel The mattresses of the beds are designed to be used as stretchers. The beds are arranged at sufficient height for the doctors to examine and treat patients conveniently, and they can also be converted into couches for the use of the slightly wounded The remaining equipment of the officers' car is the same as that of the soldiers' car

In regard to the operation and X ray car, it is of interest to note that there exists considerable divergence of opinions as to the desirability of surgical operations in a hospital train. Inasmuch as operations have been repeatedly made in cases of immediate danger to life, mainly during stoppages, it was decided in this instance to provide an operating car and to equip it as suitably as possibly with a view to rapid surgical work. The car is divided off into five separate compartments. In the middle one there is the spacious operating room proper, containing a modern five-sectioned operating table that can be readily adjusted by means of hand wheels and screws On the walls of the operating room, on either side of the operating table, are installed an instrument table, a narcosis table, a double irrigator stand, and a dressing pail arrangement on rotatable and adjustable arms so as to be placed within convenient reach of the operating surgeon There are also provided two large washing basins with hot and cold water supply, and a double stand for hand disinfection. The instrument case contains a most complete set of instruments for any surgical operation likely to be undertaken and four portable chests for medicaments, dressing, and other requisites to be carried by attendants during the doctors' visits through the hospital cars. A powerful electric lamp and mirror reflector are arranged above the operating table.

Adjoining the operating compartment is the sterilizing compartment, comprising a large sterilizer for dressing, another sterilizer for instruments, a salt sterilizer and a washing basin for instruments, with cold and hot water supply The steam required for sterilizing is produced by a special boiler at a pressure of 1.5 atmospheres. A point was made of insuring the greatest possible cleanliness and sterility, accordingly all metal parts likely to come in contact with the doctor and patients are made of polished

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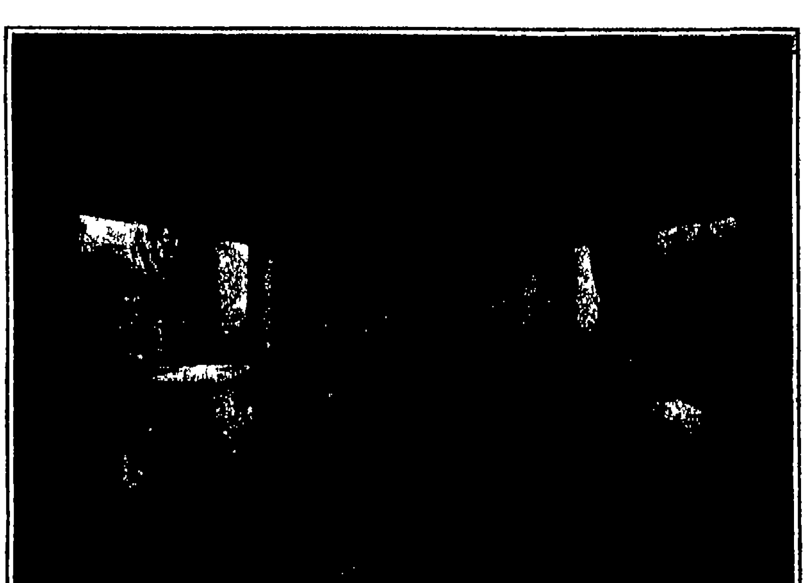
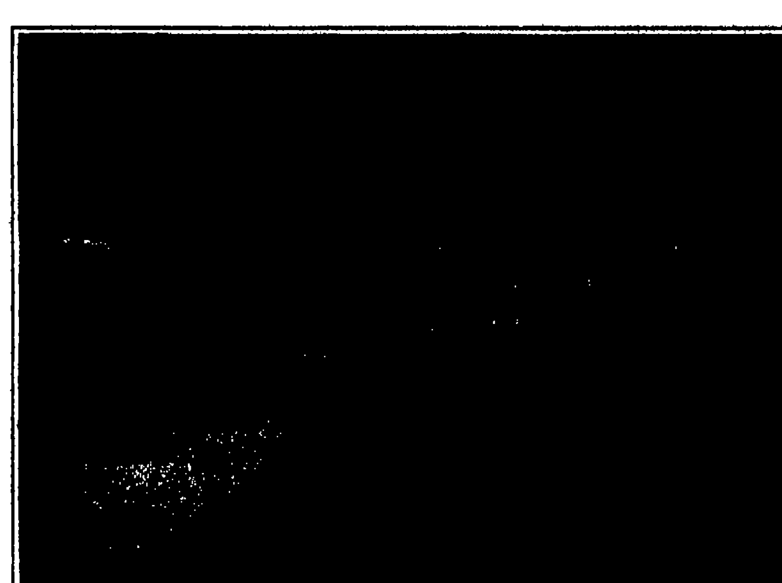


Operating room of the German hospital train, showing the elaborate equipment



Kitchen car, with the range in the center. The kitchen can cook for over 800 people

Newspapers That Are Printed Within Gun Range of the Enemy

By Jacques Boyer

IN the trenches in Belgium and France, which wind as a serpent from the North Sea to the Vosges mountains, the serious business of warfare has not succeeded in smothering the old time French gaiety in the soldiers of France. Substantial evidence of this is found in the many humorous newspapers that are being published in the trenches, within sound and range of enemy fire

It is believed that *L'Echo de l'Argonne* which commenced publication on October 26th, 1914, was the first of the French trench newspapers. Its first and second numbers were typewritten on thin paper, but beginning with the third number this interesting journal was, and has since been, printed from type. Aside from the latest news of the war, the newspaper contains much humor and even poetry.

Although other sections of the intrenched line have not been so fortunate as to have access to printing presses, the ingenuity of the French soldiers soon found a means of duplicating handwritten newspapers in quantity. A story is told of how Sergeant Bonneton, wishing to amuse his comrades of the 154th Territorial Regiment, resolved to publish a trench newspaper which would contain news, anecdotes, and even sketches representing the efforts of local talent. The captain of the company approved of the idea, and even went to the extent of furnishing the necessary paper and the copying ink. But the copying paste was still lacking so the would be publishers set about to find the all important requisite Ruined villages in back of the lines were searched and after diligent pursuit of their task the searchers were rewarded by a find of gum, as well as several cake tins for holding it But no sooner did they attempt to use the gum for copying purposes they learned to their great dismay that it was of the variety suitable for confectioners and worthless for their purpose! Finally, they sent a corporal to a certain town several miles in back of them, who succeeded in bringing back the much desired gum

The preparation of the gum into a successful reproducing device was soon accomplished, thanks not only to the ingenuity of the men, but also to a liberal collection of odds and ends gathered in the trenches Yet just as the impressions were being made and the men were about to realize their ambitions, a German 77 mm shell fell in the midst of the improvised print shop, putting the quietus on the publishing activities. Undaunted however the men recommenced their work, and in a short time the first number of the *Fanion* made its appearance in the form of over 100 copies.

Aside from German shells and other forms of interference, the French journalists at the front have other problems to face which are no less disastrous to their equipment It is not unusual for them to return from an engagement only to find that the trench rats have devoured their copying paste and paper But even this obstacle has not prevented the multiplication of these original periodicals So much interest has the French government taken in the trench newspapers that it has authorized M Charles de La Roncière to collect copies of all of them, which are to be preserved in the National Library of Paris The list of the publications alone is said to occupy over a page

Following the *L'Echo de l'Argonne*, there have been numerous trench papers started by the fighting men. Among them *Le Petit Echo du 18e Régiment d'Infan-*

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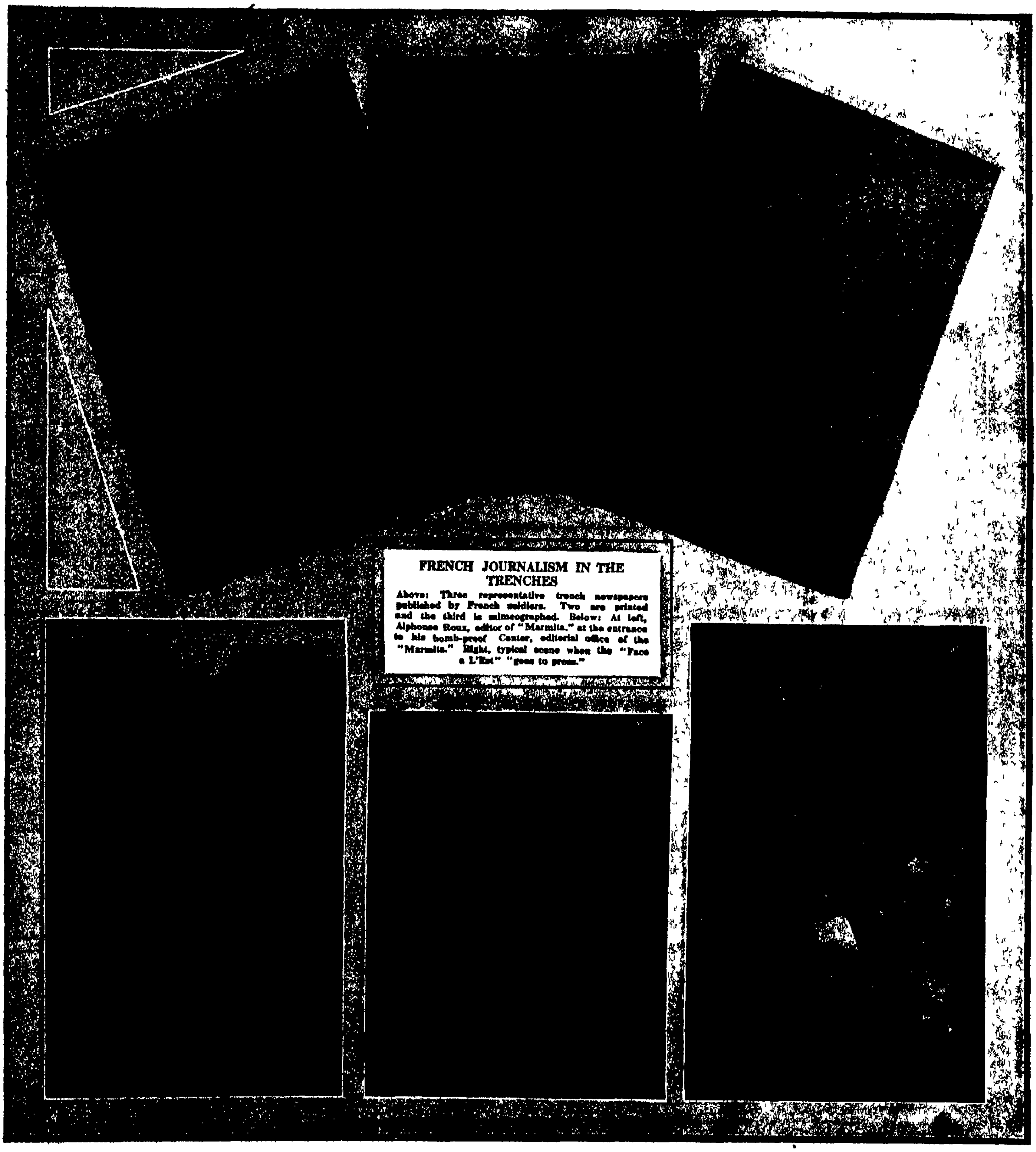

FRENCH JOURNALISM IN THE TRENCHES

Above: Three representative trench newspapers published by French soldiers. Two are printed and the third is mimeographed. Below: At left, Alphonse Roux, editor of "Marmita," at the entrance to his bomb-proof Center, editorial office of the "Marmita." Right, typical scene when the "Face a L'Est" "goes to press."

Library and bedroom corner of the four-in-one flat

Kitchen, dining room and pantry exposed to view

A Compact Apartment for the Man Who Does His Own Housework

IT would appear that E J Beall, of Cincinnati, Ohio, has solved the problem of running a womanless household His success is due to the compactness of his living quarters, which makes for a high order of efficiency with the minimum of labor In fact, the apartment consists of but one room which, by the sliding of various doors which comprise the walls can be converted into a dining room, a sitting room, a kitchen or a bedroom

The four in-one flat, for such it truly is, measures 18 by 20 feet. When the owner desires to prepare a meal he has only to slide a few partitions aside revealing a gas range, a kitchen table, chairs, sink with running water and every other convenience that goes to make an ideal kitchen When the meal is ready to be served, a few partitions on the opposite side of the room are moved, bringing into use a dining table and the necessary tableware and chairs The meal once disposed of, the doors or partitions are closed so as to remove all traces of the dining room and kitchen Other partitions are then shifted, bringing to view a few easy chairs, a library, table, electric lamps and electric fans, all of which go to make a comfortable sitting room Late in the evening when the owner wishes to retire, he goes to the remaining or fourth side of the room and behind other sliding partitions finds his big, double bed folded up against the wall He lowers the bed and moves aside a nearby partition, revealing a dresser Still, no house is complete without a bath But the designer of the four in-one flat has not overlooked this fact, two other partitions concealing this very necessary adjunct

Studying the Eyes of Wild Animals

TAXIDERMY has made wonderful strides of late. The grotesque ' stuffed ' horrors seen on exhibition a few years ago, when the defunct animal was actually stuffed, have gone The skilled taxidermist of to-day mounts his animals on a frame that is built to follow the lines accurately, so that when finished the skin is stretched taut as in life

But not content with the great strides made in the art Mr Wilson Potter a well known hunter of big game who has set up his own taxidermal workshop in Philadelphia, has been following a new line of improvement that has brought the mounted specimen to a startlingly life like appearance Few taxidermists have given any thought to the appearance of the eyes of mounted specimens The eyes have usually been selected at random from optical "various." But a study of the eyes of wild animals will show that one is quite different from another in color and expression. To put a camel's eyes in the mounted head of a lion is not true taxidermy, for the eyes of both are quite different.

Swiss watch which contains three separate movements to operate its manifold hands and dials

Working along these lines, Mr Potter has commissioned an artist to visit the various Zoological Gardens and study the eyes of wild animals at close range The result has been the preparation of a set of models of wild animals' eyes that are true to life and show the actual character of the stare of the animals. The work is still in progress, but most of the well known animals of the forest and mountain have been studied and their eyes, true to color and conformation, added to the collection of models from which the artist can copy for use in the workshop. A comparison of the head of a wild animal that has been fitted with the eyes selected at random from the stock of a taxidermist with one provided with eyes that are true to life, shows the importance of this advance in the art of taxidermy The idea also opens a new field for the artist who likes this branch of his art.

A Watch Which Performs a Score of Functions

WHAT is unquestionably a great masterpiece of both mechanical construction and artistic workmanship is presented in the form of a watch recently finished by a well known Swiss watchmaker for James W Packard, an American mechanical engineer whose name is a familiar one to Americans.

The watch is necessarily larger than the conventional pocket time piece, as may well be judged from the accompanying illustration which represents it in its actual size In fact, it is intended to be kept in a highly finished wooden box which is fastened to a wall From the box extends a silken cord which can be pulled when the owner wishes to know the time by the striking of the hours quarter hours and minutes.

Strictly speaking, the watch is more of the nature of a clock and is provided with a clock movement Its mechanism automatically strikes the hours and the quarter hours, while the repeater mechanism, which is released by a spring, strikes the hours and quarter hours and exact minutes that are indicated on the dial by the hands. Aside from the usual hour, minute and second hands, the watch contains a movement suitable for timing an event or an operation to the fraction of a second, in the form of a split-second hand and a fifth-second hand. Two additional dials are also included to indicate respectively the number of minutes and the number of hours which have elapsed during the actual use of the split-second mechanism. Another interesting

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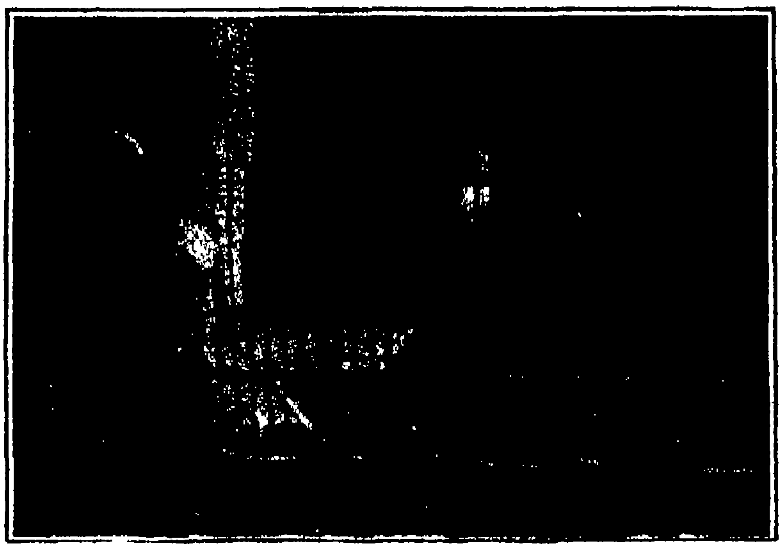
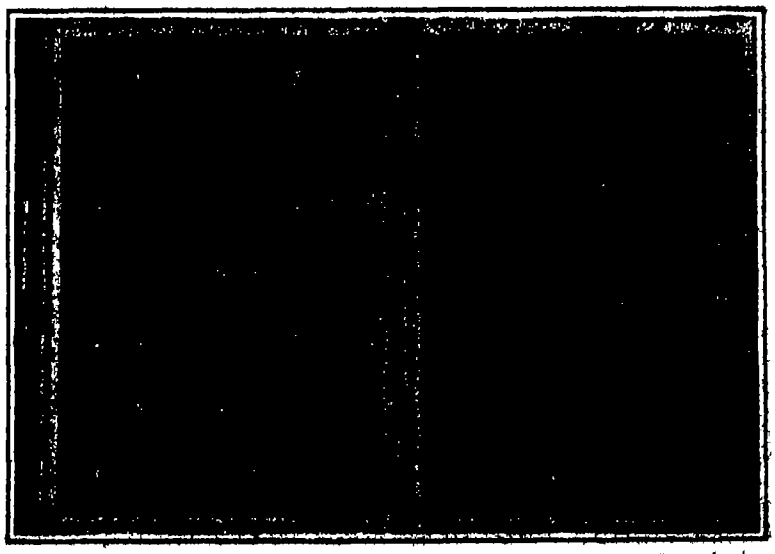


Artist engaged in painting the color and expression of a lion's eye from life



Specimen case of animal eyes, every one of which has been painted from life

Design for attaining the flying sensation by floating in fluid in a closed chamber

The Flying Sensation

Could It Be Realized?

By C Dienstbach

MUCH has been written about the "Wonders of Modern Science," yet recent developments may well impart a truer meaning to this hackneyed phrase With the artistic touches constantly being added by science to familiar achievements one may well ask whether the fairy tales hold promise of any magical powers that have failed of realization by man Wireless telegraphy was abstractly wonderful, but speaking through space to the antipodes is concrete sorcery Motion photography fell short of the true illusion of life, but "kinemacolor" may well be turned into the true magical mirror into which Faust gazed in the witch's kitchen

Artistic staging—projecting from behind upon a transparent screen, with suggestive frame and surroundings — would work wonders, but the perfection of stereoscopic features and phonographic accompaniment might well furnish realistic effects to make the spectator shiver Already sufficient steadiness has been achieved to make possible the perfect superposition of twin pictures through properly focussed telestereoscopes; and what promise of startling effects in distance-variation are held forth by the phonograph! In scanning all the treasures of dreamland presently to come true, but one thing appears missing, the most cherished of all — the privilege of superhuman beings, the sensation of flying True we have flight but not yet the "flying sensation" Next the ground an aeroplane passenger cannot say whether he is rolling or flying In a Zeppelin one feels as on a river steamer The novelty is all in the view, yet even this is to be in large measure obtained from a railway trestle That we are carried by the air does not alter the sensation of actually sitting as in a chair and sensing the workings of gravity

How different from flying as it feels in our dreams—that supreme pleasure of floating in a space freed from gravity, of effortless soaring at will whither we please This is indeed the flight of fairies Scant reason have we to envy even the birds for any supposedly similar sensation, they can hardly escape feeling the pull of gravity at their wing bases and in their bodies, suspended as between parallel bars Still, it would seem interesting to probe whether, like the other wonders of the fairy world the rare sensation of dreamflight might not be reproduced and all the more so since this happens to lead us to a striking inspiration of a great poet

There is one infallible way of producing a floating sensation—immersing the body in a fluid of equal specific weight But this sensation of floating is inherently opposed to one of flying because the very density of the medium hinders motion Otherwise swimming might be more than exhilarating How could we artificially circumvent this natural contradiction? Simply by moving not painfully *through* the fluid, but at will *with* the fluid This principle chances to coincide with Goethe's strangest inspiration the "Homunculus" in Faust that chemically created human being endowed with magic powers chiefly that of flying but always within its confining glass vessel The sensation of flying is necessarily realized if the body is floating in a vessel carried by an aircraft If the supporting fluid and part of the vessel are perfectly transparent and if the flight's direction is in a simple way under instant control This involves a number of subsidiary

(Concluded on page 672)

The sensation of flying, as we dream it and as Goethe pictured it

Suit designed for wear in the flying chamber

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Interlocking Channel Brick for Walls of Attractive Design

ALTHOUGH the numerous advantages of brick over other forms of construction in the building of country residences have long been recognized and fully appreciated by both the architects and home builders they have continued to use wood profusely for no better reason than the fact that brick walls are usually unattractive and decidedly monotonous It is difficult indeed to beautify the exterior of a brick home Even

Section of a wall built of interlocking channel bricks, showing two-inch air space

stucco and concrete have been employed in place of brick, but since the former is not always satisfactory and the latter possesses the quality of being essentially unhomelike, it is evident that these substitutes rarely attain the ends for which they are intended

With a view to overcoming the unattractiveness of brick walls and at the same time take advantage of the heat and cold insulation of hollow walls, there has recently been designed an interlocking channel brick of novel design As will be noticed by referring to the accompanying illustration, the new brick provides a double, hollow wall with an attractive brick face It consists of two solid masonry walls each 3 inches thick, which are calculated to withstand fire and water The double walls, it will further be noticed, are separated by a 2-inch air space, yet are bound inseparably together by webs made integral with the brick itself.

It is claimed by the designers of the new brick that it possesses nearly double the strength of a solid wall made of common brick and is over 25 per cent stronger

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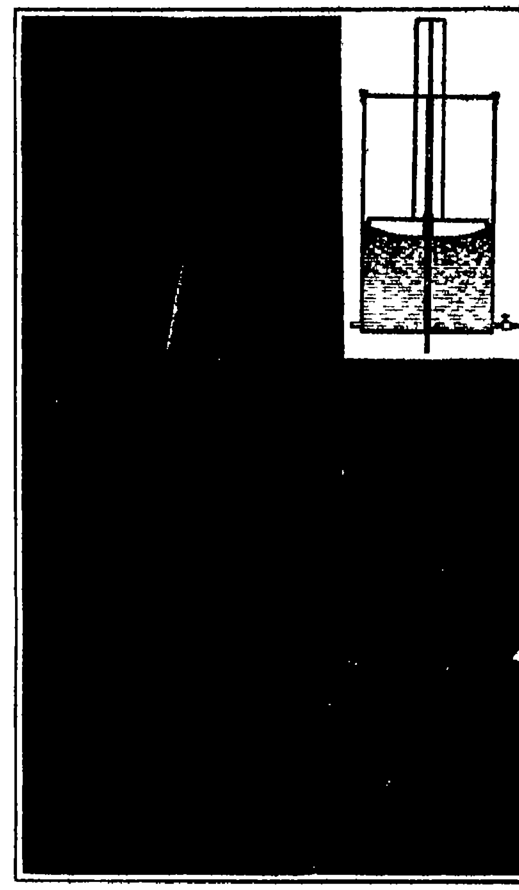
A Liquid Measuring Device

SIMPLICITY and accuracy have been the cardinal aims of W C Lindsay of Newport Va, in designing a measuring device for tanks on which he has been granted a patent While the measuring device can be used for liquids of all kinds, the inventor has found it particularly applicable to gasoline supply for automobiles and in this connection he states that upward of 20,000 gallons of fuel were passed through such a meter last season with perfect results And the very simplicity of the meter, which is illustrated in the accompanying picture has caused it to be popular with the public

In the cross-sectional view of the device it will be noted that a large disk like float is used in a metal cylinder In one type of apparatus two upright rods are attached to the float These pass upward through the top to a cross piece The latter is connected to a rod which passes downward through a tube placed in the center of the tank and terminating at its lower end in a single or double pointer In back of the pointer is placed the scale graduated in gallons or any other suitable unit of measurement A modification of the design just mentioned consists of a similar float to which is fastened a small chain that passes upward and around a pulley on top of the lid of the cylinder,

(Concluded on page 672)

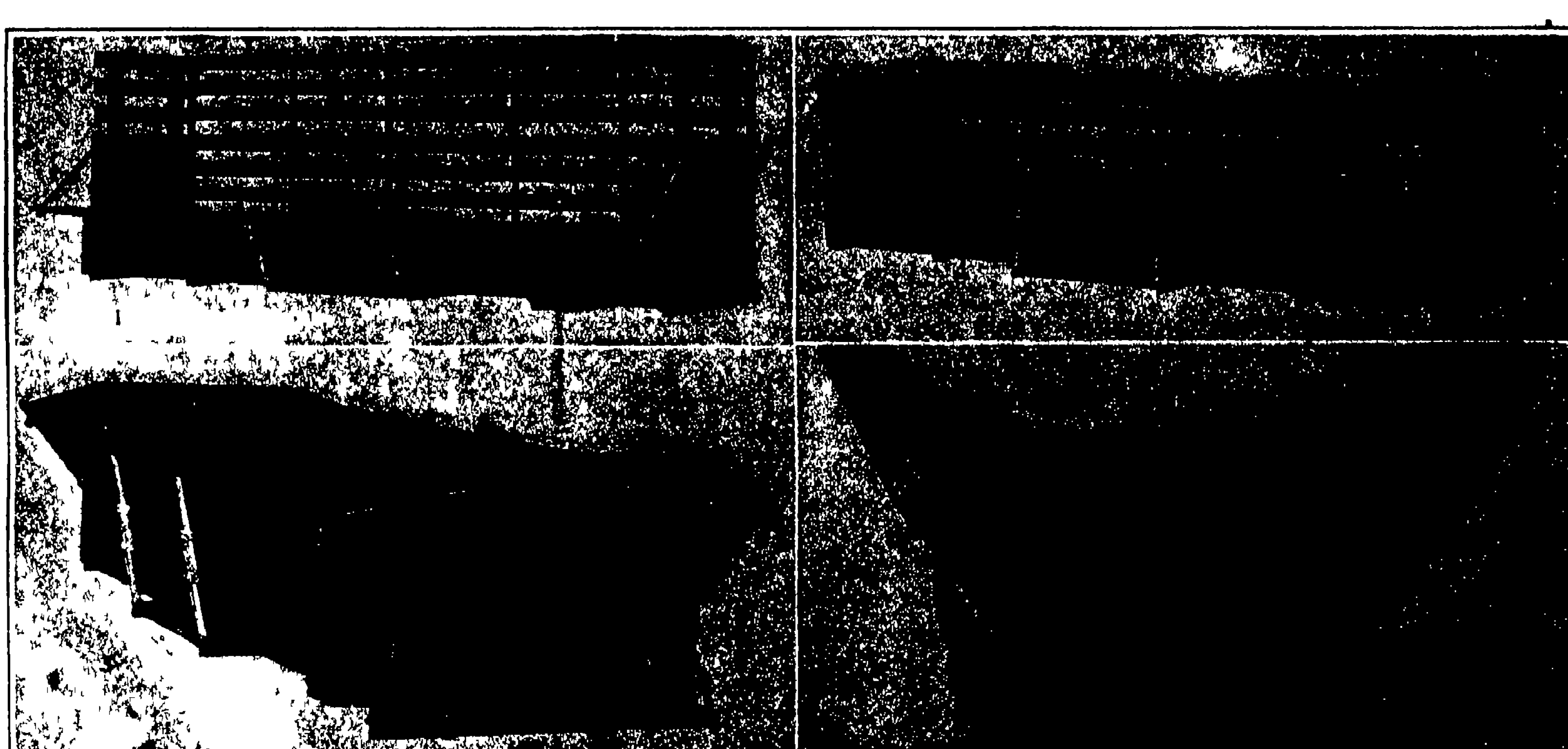


Measuring device for filtered gasoline and a cross-section of the operating members

Eight Wagon Bodies in One

DESIGNED particularly for use on farm wagons and motors which have to carry a great variety of goods throughout the year, the wagon body shown in the accompanying illustrations can be converted into eight different and distinct forms in a few minutes, without the addition of a single bolt or piece of wood By the use of this body, the farmer is able to carry economically anything from hay grain or produce to live stock. As shown in the pictures the body is characterized by collapsible sides formed of slats, which may be folded close together to form a grain tight box (as in Fig 3) or extended to permit the carriage of larger quantities of light bulky goods.

With the slats closed, the sides may be put in the position shown in Fig 3, or may be turned straight up giving a rectangular box With the slats open, we get a body as in Fig 4, with great carrying capacity In either event one or both sides may be turned down, as in Fig 1, for convenience in loading or unloading, and for display and sale of goods. Various other dispositions of the sides are possible, but perhaps the most striking is that shown in Fig 2, affording a closed cage for the transportation of live animals



Wagon body adaptable to various purposes

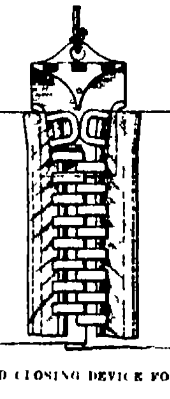
1 Showing side of body lowered for loading, marketing etc 2 Body folded together into cage for transportation of live stock 3, 4. Two positions of body for ordinary loads

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel

OPENING AND CLOSING DEVICE —F KRICH 1015 Trinity Ave Bronx New York N Y This invention provides a device for use on shoes corsets dresses and other articles of wear and is arranged to enable the wearer to securely and conveniently open and close the article Use is made of interlocking mem



OPENING AND CLOSING DEVICE FOR APPAREL

bers arranged on the parts of the article to be fastened together and a manually controlled slide adapted to engage the said interlocking members on moving the slide in one direction to unlock and open the said members, the slide on being moved in the opposite direction closing the said members

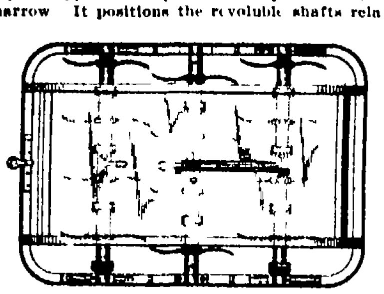
Electrical Devices

PORTABLE ELECTRICAL MEASURING INSTRUMENT M B KASSEL and A FINKENBERG Address the latter 619 E 181st St New York N Y A specific object of the invention is the provision of a novel ammeter coil which when traversed by current creates a magnetic field the strength of which is indicated by a scale carrying armature whereby the strength of the current can be ascertained by a direct reading from the scale

BACKING UP DISTRIBUTOR — E KEEFE care of *Collier's Weekly* 416 W 13th St New York N Y This invention provides means for uniformly distributing the molten metal forming the back of an electrotype provides means for straining the molten metal as it is poured over the copper shell to form a support therefor and provides such a device which is independent of the electrotype and the tray whereon it is placed for backing up thereby enabling an operator to place the same at any position on the tray

Of Interest to Farmers

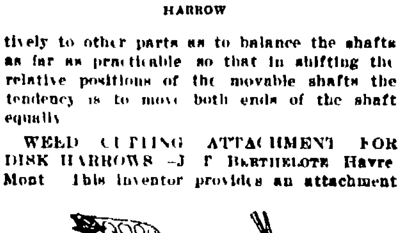
HARROW – E W BJORKMAN Weldon Sask Canada This invention enables the operator to control the general relative positions of certain revoluble shafts provided with teeth from a point approximating the middle portion of the harrow It positions the revoluble shafts rela



HARROW

tively to other parts so as to balance the shafts as far as practicable so that in shifting the relative positions of the movable shafts the tendency is to move both ends of the shaft equally

WEED CUTTING ATTACHMENT FOR DISK HARROWS —J F BARTHELOTE Havre Mont This inventor provides an attachment

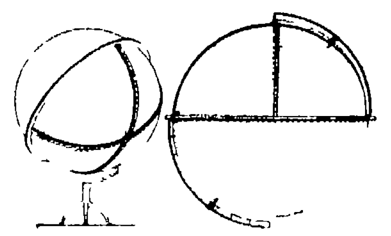


WEED CUTTING ATTACHMENT FOR DISK HARROWS

which may be readily applied to disk harrows of standard makes and provides means for raise and lower the weed cutting blades the whole to be bodily attachable to and detachable from the harrow frame It also provides an attachment arranged to dispose the blades adjacent to individual disks at the base of the disks.

Of General Interest

GLOBE RULER AND PROTRACTOR.—G H CASSEL 38 South St, Middlebury Vt This invention provides an apparatus adapted especially for use upon globes for experimental or demonstrating purposes in classrooms, lecture halls laboratories or the like for instruction along the lines of geography of the globe spherical geometry and trigonometry astronomy, and the like By means of it cir



GLOBE RULER AND PROTRACTOR

cles of all sizes are drawn on a slated globe spherical angles are measured and spherical triangles are drawn and graphically solved The chief advantages of this device over its predecessors lie in the quickness with which the mechanism may be applied to the globe the complete freedom from interruption and breaks in the drawing of great and small circles

PROCESS FOR TREATING THE JUICES OF THE AGAVE PLANT –L LAVEDAN 2522 Berlin St New Orleans La An object in this case is to provide a process for treating the juices of the agave plant which will bring these juices to such a condition that the subsequent steps taken in the manufacture of the various products such as alcohol syrup or molasses are rendered extremely simple, thereby insuring an economical product

PROCESS FOR TREATING ROCK CONTAINING ALKALI METALS —F L THIRSBAUGH, 108 Plaza Drive Berkeley Cal The object of the present invention is the provision of a simple and economical process for converting the alkali contained in the rock into soluble sulfates and then separating the potassium salt from the sodium salt generally present therewith

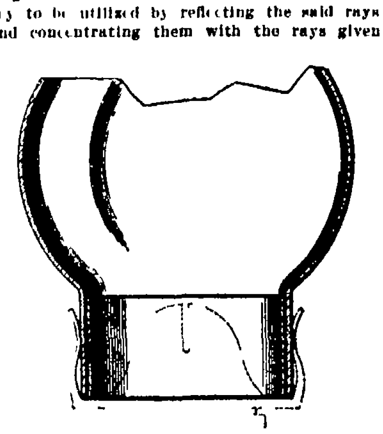
Hardware and Tools

JEWELER'S TOOL I ROSENBAUM, Mount Vernon Ind This invention has reference to a tool for use by jewelers in re-sizing finger rings or like bands An object is to improve a tool for the indicated purpose, in which one of a pair of ring holding jaws is provided with grippers arranged as adjustable gage elements

DOOR LOCK —M F RICHARDSON, 107 E 128th St New York N Y The purpose of the invention is the provision of a new and improved door lock in which the bolt automatically swings back into folded position within the door casing on opening the door thus forming no undesirable projection when the door is open

Heating and Lighting

LAMP CHIMNEY —G W LINDSEY, Berrys Va The invention has for its object to provide a mechanism for use in connection with lamp chimneys of any character for permitting the rays emitted at the base of the chimney to be utilized by reflecting the said rays and concentrating them with the rays given



LAMP CHIMNEY

out above and at the flame wherein the said means may be an integral part of the chimney or a separate article of manufacture permanently or temporarily attached to the chimney

ILLUMINATING DEVICE FOR LIFE LINES —J C CERICOLA 226 High St Brooklyn N Y N Y This invention relates to illuminating devices and particularly to devices for illuminating a life line as the same is projected from the gun toward a stranded ship and has for an object the provision of an arrangement which will cause a light to be produced as soon as the line starts on its travel and to be maintained during the entire travel of the line

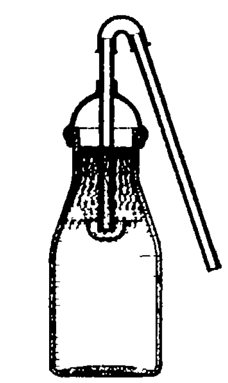
Household Utilities

WINDOW SASH ATTACHMENT —G. W POULTON, 5818 Larchwood Ave West Philadelphia The invention provides an attachment whereby an ordinary sliding sash can be transformed into a swinging sash It provides an attachment whereby the swinging sashes can be utilized as ventilators and provides an attachment whereby the sashes can be maintained at predetermined angles, thereby rendering the ventilation adjustable and also permitting the cleaning of the windows from within

FLY TRAP —H M MYERS, 220 4th St, San Rafael Cal This invention has reference to fly traps, and has for its general objects the provision of a fly trap of comparatively simple and inexpensive construction, of durable design and having simple and effective means for enabling the trap to be readily cleaned out

DUST COLLECTING BAG FOR VACUUM CLEANERS —ALICE N MUMMERT Address, E E Mummert, 110 N Main St. Goshen Ind. This bag is constructed of a single blank section of paper or cloth capable of convenient attachment to and removal from a vacuum cleaning machine the device being so inexpensively constructed that after it has been filled with dust and sweepings it may be destroyed or burned with the latter thus obviating coming in contact with or inhaling the dust and dirt

CREAM REMOVER —F S DOUGANS, 30 Henry St Clinton Mass The invention relates to a device for household use in siphoning cream from milk bottles It provides a cream remover of the indicated character improved more especially from a sanitary point of view and to the end that efficiency in operation may



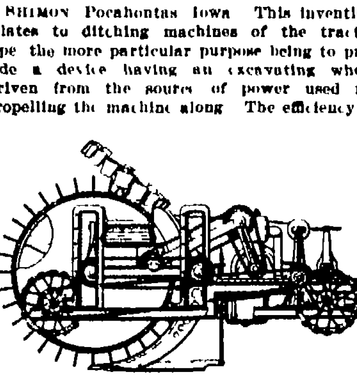
CREAM REMOVER.

be relied upon The siphon legs are designed for a single service to be then discarded in the interest of sanitation Also the other elements entering into the structure are of a character to be cleaned with thoroughness and facility

STOVE OR FURNACE FEED —F S SEYMOUR Manchester Iowa An object of the present invention is the provision of an automatic coal feeder particularly adapted for feeding coal to small heating stoves ranges, house boilers tank heaters feed cookers and the like on which there is not a very large consumption of coal

Machines and Mechanical Devices

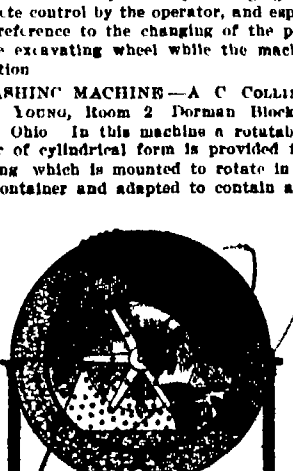
DITCHING MACHINE —J L CONROY and J SHIMON Pocahontas Iowa This invention relates to ditching machines of the tractor type the more particular purpose being to provide a device having an excavating wheel driven from the source of power used for propelling the machine along The efficiency of



DITCHING MACHINE

the machine is improved by arranging for its complete control by the operator, and especially with reference to the changing of the position of the excavating wheel while the machine is in action

WASHING MACHINE —A C COLLINS and J E YOUNG, Room 2 Dorman Block Coshocton Ohio In this machine a rotatable container of cylindrical form is provided for the clothing which is mounted to rotate in a second container and adapted to contain a liquid



WASHING MACHINE

charged with a detergent, and wherein mechanism is provided for scooping up a portion of the liquid and passing it into the first named container, and forcing it through the clothing in the container, during the rotation of the first named container, and wherein heating mechanism is provided in connection with the second named container for heating the liquid during the operation of the machine.

VARIABLE SPEED GEARING.—J. W CAMPBELL, P O. Box 37, Detroit, Mich. The invention provides a combination gearing by means of which various speeds may be imparted to the driven shaft, and in which the change from one speed to another is accomplished by means of clutch members, without the necessity of shifting gears out of or into mesh with certain other gears Mr Campbell has invented another variable speed gearing which provides a gearing wherein the driving shaft and the driven shaft are arranged to be connected directly or at varying speeds through the intermediary of a countershaft, and wherein a common means is provided for controlling the direct connection and the connection between the countershaft and the driven shaft in alternation in such manner that the driving and the driven shafts may not be connected directly without releasing the driven shaft from the counter shaft

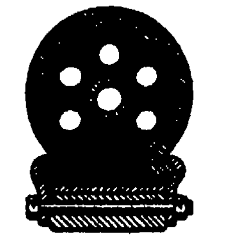
Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE —E C GUNDELACH, 14 Union St New Rochelle, N Y The engine is arranged to insure a thorough exhaust of the products of combustion, to prevent the incoming new charge from mixing with any products of combustion, to provide ample admission space for the explosive charge and to prevent accumulation of the carbon deposits in the cylinder and fouling of the electrodes of the igniting device.

TOOL FOR REMOVING ENGINE VALVES —C M WILKERSON, Middlefield Ohio The invention provides lever arms arranged to be given a separating movement by a cam lever whereby to compress the valve spring and relieve the usual cotter pin of spring pressure so that the pin may be readily removed The arrangement of the cam lever relative to one of the lever arms is such that said lever arm will be rocked to compress the spring and will then be locked to maintain the spring under compression

Pertaining to Vehicles

CUSHIONING BODY FOR CASINGS —F ZUBER 210 Logan St Brooklyn, New York, N Y This invention relates to cushioning bodies or fillers for tire casings, and an object



CUSHIONING BODY FOR CASINGS

is the provision of a construction which will produce a resilient effect while being sufficiently strong to support any reasonable load It provides a hollowed-out filling or cushioning member for producing a resilient effect without the use of compressed air It provides a cushioning filling body for tire casings arranged in sections with means for holding the same together whereby any part may be readily renewed without it becoming necessary to renew the entire filling body

Designs

DESIGN FOR A HOMESHRINE.—J J MCGRANE 505 5th Ave, New York, N Y This invention comprises a facade-like panel or niche, an image of the Virgin Mary and Child set in the niche, a cross surmounting the panel, and a lamp at the foot and in front of the image.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—W E. HUNTER, care of Economy Tumbler Co Morgantown, W Va This design comprises a vase with handles at its sides, and with a leaf design at its bottom and feathers at its top At each side is a rosette, the rosettes being connected with the vase by chains of pearls and above each rosette there is a flame, and below a floriated pendant.

DESIGN FOR A CANOPY FOR GAS AND ELECTRIC FIXTURES —C J ALCAN, address Reliance Metal Spinning Co, 15 Laight St, New York, N Y This ornamental design for a canopy for gas and electric fixtures is No 49 104. Mr Alcan has also invented four other designs for gas and electric fixtures as follows DESIGN FOR A SHOWER PLATE FOR GAS AND ELECTRIC FIXTURES This is No 49,105 DESIGN FOR AN OVAL BACK FOR GAS AND ELECTRIC FIXTURES. This is No 49,106. DESIGN FOR A SOCKET COVER FOR GAS AND ELECTRIC FIXTURES This is No. 49,107.

DESIGN FOR A LIGHTING BOWL.—M D BLITZER, Gas and Electric Appliance Co., 569 Broadway, New York, N Y. This ornamental design for a lighting bowl is No. 49,109

DESIGN FOR A REFLECTOR.—P SIMPSON, 138 W 116th St., New York, N Y This ornamental design for a reflector is No 49,129.

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The Spruce Gum Industry

(Concluded from page 660)

bottom of the box and the funnel is stretched fine cheese cloth, while the top is covered with burlap upon which the chip gum is spread in a thin layer Steam is admitted to the box through an opening in the side and passes out through the burlap The gum melts and runs through the burlap and cheese cloth strainers and into a tin receptacle below the mouth of the funnel

While the gum is still warm it is taken out of the receptacle and worked or pulled This makes it more uniform in density and lightens the color It is next laid on a bench and rolled flat with heavy rollers the last one having heavy dies cut into it to separate the gum into small sticks or squares These are wrapped in tissue paper and sell in the retail market for about one cent apiece

Some makers adulterate their steamed gum by introducing rosin Others mix it with chicle One formula for the latter calls for 20 parts each of spruce gum and chicle and 60 parts powdered sugar The gums are melted separately mixed while hot, and the sugar immediately added a small portion at a time, and kneaded in on a hot slab When the sugar is completely incorporated the mass is removed to a cold slab previously dusted with sugar rolled out at once into sheets and cut into sticks

The true lover of spruce gum is not attracted by such hybrids His test of good gum is first in the taste and then in the color When the lump is first crushed in the mouth there should be an agreeable bitterness but no trace of turpentine The particles should soon adhere together in proper consistency turn to a light lavender shade and retain the characteristic flavor indefinitely

A Model Hospital Train

(Continued from page 664)

nickel, and all other parts are white enameled The walls and ceilings of the sterilizing compartment are white varnished, and in their lower portions are covered with a varnished cloth that is readily washed

The chemist's compartment is situated beside the sterilizing room, and comprises all medicaments and provisions in two spacious cupboards In another compartment of the car there have been installed X ray outfits enabling the wounded to be rapidly inspected before being operated upon. The apparatus is also used in inspecting plaster dressings The induction coil of the X ray apparatus receives its primary energy from the train lighting circuit, and the bulb is readily adjusted along the radioscopic table

Since the possibility of conveying soldiers suffering from infectious diseases had to be accounted for, a special disinfection car has been included in the hospital train This car is fitted with every possible facility to reduce the risk of infection to a minimum The disinfector is designed for disinfecting the body and bed linen of patients, their mattresses, pillows etc, in a stream of live steam at a temperature of 108 to 110 degrees In order to enable even clothes, leather and other articles to be sterilized, the same apparatus has been designed for formaline disinfection Furthermore with a view to destroying vermin, so dangerous in time of war, physical disinfection with carbonic acid and hot air has likewise been provided for A steam washing machine insures a preliminary cleaning of blood stained and dirty linen Steam for this machine and the disinfector is supplied from a steam boiler installed in the car Two spacious receptacles lined with sheet metal serve to store dirty linen not infected and disinfected linen, respectively In a cabinet there is a shower bath for the doctors and the attendants

The lighting car is in reality a power plant on wheels, and supplies electrical illumination to all the cars. The latter are equipped with compressed gas apparatus to be resorted to in case of emergency Electricity is generated by a generator direct-coupled to a 12-horsepower four-cylinder gasoline motor The load

consists of about 380 lamps. A storage battery of 60 cells supplies current while the generator is at rest

The two cars reserved for the doctors, female nurses and clergymen each comprise nine separate compartments containing a convertible bed sofa, a wardrobe, a washstand containing a set of drawers and also available as a writing desk, and a spacious chest for personal belongings In a special compartment of the doctors' car there is the chief surgeon's office The attendants cars are fitted out in a similar manner to the soldiers' cars, each containing 10 berths in addition to a dining table and chairs The manager's car comprises three compartments, the dwelling room and office of the superintendent being installed in the central one

The kitchen car is provided with a range of about 10 feet in length designed for the needs of 300 persons The cooking utensils are partly of aluminum and partly of pure nickel Enameled crockery is used for dishes, insuring the greatest possible cleanliness A portable, closed chest is used for transporting the food from the kitchen to the other cars, thus keeping it to the desired temperature The kitchen storage car contains ample provisions for one or two weeks, as well as a water tank of about 2 700 gallons' capacity The linen car contains 650 blankets 600 sheets 1,000 tablecloths, 1 000 towels napkins etc 1 000 arm bands neck cloths handkerchiefs etc 300 "sick" suits, and a large number of other pieces of linen

One of the baggage cars provides sleeping accommodations for the railroad personnel, and carries a large water tank Another car carries a large provision of coal for heating A further supply of coal is carried in a special car at the end of the train

Each car of the train carries a telephone thus permitting of ready communication between the different departments of this hospital on wheels. Water tanks of an aggregate capacity of over 21,000 gallons are installed in the various cars The train is made more pleasant by a number of paintings and a small organ, phonograph and library are provided to make the days of the convalescing patients most agreeable.

The Flying Sensation

(Concluded from page 667)

problems—respiration while immersed, perfect vision elimination of the wetness and saltness of a concentrated solution by comfortable watertight clothing, maintenance of the fluid at a pleasant temperature

How delightful such flying must be is realized if we consider that a perfect illusion of emancipation from gravity and the fear of falling automatically renders dizziness impossible A self adjusting safety valve could maintain a constant normal air pressure within a closed vessel and do away with the hardships and dangers incident to changing altitude How different from previous altitude flights—from the supreme efforts and chastisements of the toughest athletes! That the mere exposure to the icy blast which supports the machine and the need of bundling up like an arctic explorer in itself annihilates any likeness to a flying sensation has been realized by designers who placed the fliers in glass enclosures It might be advisable to add some details in contradiction of any vision of a 'flying bathtub" The device suggested by the logic of physical and physiological facts is not unlike the current practice of strapping fliers into deep cockpits The first Wright aeroplane carried for years an operator lying prone A layman will frequently not realize what flotation means and why an ounce of water could be made to float a ton of wood in the form of a cube closely fitting a tank This water should be compared to a quantity of lubricated fine shot and if the wooden block is likewise imagined extremely slippery, the heavier shot will obviously slip under the wood and raise it

Floating" a flier prone on his stomach in a long, narrow closed cockpit could be done by a few pounds of salt water If this thin film were found to interfere with a perfect view of the outside world through goggles and 2 square feet of glass a short distended hose could be inserted to give the flier a path of vision through air A pleasant sensation would be insured, and the submerged glasses kept clear by circulating the water through a heater to keep it lukewarm The cockpit's rubber sides and bottom, closely fitting the flier's body, might be upholstered, although accelerations and centrifugal force are neutralized the same as gravity if the whole pit is flooded Balancing and other technical cares of flight must of course be left to an aerial chauffeur and only direction and speed be controlled through a simple device

The novel subject may be brought home by remembering the part played in medical treatment by permanent partial floating of a body incapacitated from supporting its own weight For artistic illusion, *of course, flotation must be more complete* than this The effort it takes to keep sustained even in the ocean, and the sensation of being wetted by cold water, add to breaking the spell in bathing For a flying illusion not only must the brine be heavier than sea water and the head submerged, with ventilation and temperature such as to give a sensation of immersion in the atmosphere alone but a peculiar diving suit must eliminate wetness and irritation to the eyes ears and nose in breathing This garment has little resemblance to the familiar suit for deep-water diving The thinnest fabric suffices, and the head covering must be uniform with the rest of the suit, because any rigid helmet would feel like a material support.

A short, flexible, ventilated hose, extended by rings, makes breathing easy Glasses inserted before the eyes give the illusion of looking through air The real problem consists in so ventilating this suit that the sensation is like that of being surrounded by air and yet afloat. It could be solved by a fine spongy lining built up of perforated rubber tubes branching out like veins Air is continuously forced in and sucked out through interlacing systems of tubes, the lining absorbing and distributing it The quantity is too small to feel like any outside support and the suit is too light and flexible to interfere with the floating sensation

Conversation between the passengers in adjoining cockpits could easily be made possible, thus permitting better enjoyment of flight by a company of soarers For this purpose a sound-conducting covering over the ears would be necessary, and the breathing tubes which would carry the conversation, would have to issue into a common air space, with continuous in feed and escape of air under constant normal pressure Also, in the ceiling confining the fluid against inclination, centrifugal force and acceleration a sound conducting diaphragm would be necessary

This seems all a striking illustration to Homunculus' words

" For what is natural scarce the world has place,
What's artificial needs restricted space "

Newspapers That Are Printed Within Gun Range of the Enemy

(Concluded from page 665)

terie Territoriale which is conducted under the editorship of Corporal Huguet and autographed in different colored ink for each issue *L Echo des Tranchées*, edited by the well known French author Paul Reboux and containing articles and poems from the pens of such celebrities as Poincaré and Rostand Théodore Botrel and Henri de Régnier, *L'Echo du Carrefour*, which is written on a typewriter *l Echo du Ravin* of the 41st Battalion of Chasseurs, and many other *Echos* which are characterized by their interesting and brilliant contents Strange enough there is little reference made in these novel periodicals to matters of warfare, rather they are replete with local gossip, jokes, cartoons and similar matter tending temporarily to remove the thoughts of the readers from the horrors of conflict

Continuing our survey of the trench newspapers, we come to the illustrious *Face à l'Est*, the organ of the 91st Territorial which has been printed on a copying machine in the Argonne region since August 1st, 1915. It is issued every Sunday—provided the opposing Germans do not seriously object, the fourth number of the journal, for instance, was withheld for several weeks because the editors and printers were rather busily occupied in settling a little dispute with the Germans

Aside from the word *Echo* in their titles, the trench papers appear to be most partial to *Poilus*, hence there is a wide assortment of titles making use of that name For instance, among others there are the *Poilu Déchainé*, the *Poilu Grognard* *Les Poilus de la 9e* founded in March, 1915 and *Le Poilu*, directed by Dr Vève Printed at Châlons-sur Marne, the last-named is one of the most important of the trench newspapers since it circulates more than 18,000 copies

Prominent is the *Marmita*, which is, according to its publishers, an ' anecdotic humorous and fantastic " review It came into existence on the banks of the Aisne at the beginning of 1915 It is directed by Adjutant Paul Clerouc, aided by several collaborators, among them Engraver A. Deslignieres, and Second Lieutenant of the Reserves A Roux, professor of a university Although elaborately printed in Paris, the *Marmita* is edited in a modest dugout which is quite devoid of the usual comforts of an editorial sanctum

Still other journals are the *Cri de Vaux*, *La Voix du 75* and the *Woevre Joyeuse Rigolboche* is another journal which is entirely devoted to poetry of the most humorous sort with occasional contributions from Emile Faguet and Henri de Régnier

Perhaps the most unique of the journals is *L'Echo des Marmites*, which is worded entirely in the strange new terms of the trenches Its laugh-compelling articles are rendered still more humorous by the peculiar expressions and words which the soldiers have come to use both for military and everyday terms

L'Echo de Guitounes, *L'Echo de Gourbis*, *La Chechia*, *Diable au Cor* the *Boyau* and the *Hareng Verni* are among the most conspicuous trench papers that have not been mentioned before

A Watch Containing Every Refinement Known to Horologists

(Concluded from page 666)

feature of the watch is the perpetual calendar which makes allowances for the 31 30- and 28-day months and even the 29 days of February each Leap Year The phases of the moon can be instantly determined by referring to a crescent shaped opening in the upper center of the dial Lastly, a most useful attachment is incorporated in the watch to indicate when the gong movement and the watch movement were last wound.

The gold used in the case of the watch is 18-carat and weighs nearly seven ounces Three separate mechanisms are required to perform the various functions of the watch, two of them are wound by turning the winding stem in one direction and the remaining movement wound by turning the winding stem in the opposite direction.

Peculiar interest is attached to the watch at the present moment when the greater part of Europe is involved in a gigantic conflict which is retarding the progress of hand work and artistic creations It is noteworthy that Swiss workmen surrounded on all sides by fighting millions should continue in their normal occupations

A Liquid Measuring Device

(Concluded from page 668)

and then down through a tube in the center of the reservoir, terminating in a single or double pointer To prevent the float from turning it is provided with a single projection which slides between guides running down the inside wall of the cylinder

By opening an ordinary valve the measuring device is quickly filled, and the quantity of liquid entering into the tank is absolutely controlled. By a similar valve in the nozzle at the end of the outlet tube, the escape of the liquid is similarly controlled, discharging its contents as fast or as slow as desired. Gasoline, for instance, may be elevated to the measuring device from a storage tank in the ground by hand or power pump, air pressure, hydraulic pressure, or by gravity fall.

Interlocking Channel Brick for Walls of Attractive Design

(Concluded from page 668)

than a hollow tile wall Owing to the channel feature of the new brick, there is no possibility of moisture traversing through a wall built in this manner The solid double walls, separated by closed air cells, provide maximum heat and cold insulation, hence there is a considerable saving effected in the heating expenses of a home built in this manner "

As for exterior appearance, the interlocking channel brick is made in such a variety of shapes, sizes, textures and colors that almost any variety of effects can be secured in the walls built of it

Rock Tunneling Without the Use of Explosives

(Concluded from page 657)

is slowly carried over the face of the tunnel The line pressure of 80 pounds per square inch exerts a constant force on the tool holder of each hammer, keeping the tool out. When the tool comes in contact with some obstruction in its path, however, the hammer is automatically and independently operated, delivering a blow of from 7 to 10 tons pressure on the chipping tool. If the obstruction has now been chipped off the face—and it almost invariably is—the hammer remains passive until the next obstruction is encountered

Each cutting tool chips away a circular path or track of its own the work of all the tools giving the face of the tunnel the appearance of a rifle-practice target because of the large number of concentric rings. Each hammer may deliver as many as 1 000 blows per minute In soft material the hammers do not function, instead, the tools, carried around by the rotary head, act as gouges until hard material is again encountered

The compressed air which operates the hammer drills also supplies the necessary motive power to rotate the head and turn the screw jacks that push the front member steadily up into the work. A simple form of double acting engine, operated by compressed air is used for driving the rotating head shaft and for turning the screw jacks, as well as for operating the muck shovels and conveyor The rock that is chipped off by the hammers is in the form of fairly large pieces which run as high as 10 pounds in weight. As the muck accumulates beneath the rotating head, it is scooped up by shovels that are rigidly mounted on either side of the former member, and unloaded on a conveyor belt that carries it to the rear of the machine, where it is dumped into small cars

To those who have read the description of the rock excavator that appeared in a previous issue of the SCIENTIFIC AMERICAN the foregoing description fails to reveal new points regarding the rock excavator Yet Mr App has been constantly working on the details of his intricate machine in a manner that only fellow inventors can appreciate. As a result of this important if not manifest work, the machine has been brought to a state of development, where it has successfully bored through over 70 feet of rock in connection with the work on the new subways of New York Here it has encountered not only quartz rock, but also strata of gneiss, which is perhaps as hard a formation as is ever encountered in tunnel work. Runs of over one hour duration have been made without shutting down once, and the tools have stood up for a distance of twelve feet without dressing or renewal.

Among recent performances to its credit the rock excavator has cut 15 inches of 8-foot tunnel in 95 minutes, and 5 inches in 35 minutes, the latter being a non-stop run. On June 9 tests were conducted in the presence of the Interborough and

Rapid Transit Subway engineers, in which the machine cut 2½ feet in 3¾ hours' operating time. At the end of the run the machine was in good condition and cutting faster than at the beginning and the tools did not require any dressing or renewal according to Mr App At the time of the previous description in these columns the machine was still in its experimental state and had not yet encountered the severe conditions of actual use

Among the recent refinements has been the redesigning of the rock-chipping hammers resulting doubtless in the doubling of the weight of the piston, strengthening the tool and its holder, and making the mechanism simple and dependable in operation and less liable to breakage The angles at which the tools are held in relation to the work has been solved after much study and experiment and now the concentric cuts assume such a form as to have each tool cut a clearance for the tool proceeding it. Each rotation of the head chips off the rock face to a depth of one inch advancing the tunnel that distance forward A future development of the machine will be the elimination of the tracks and the use of herring bone tired wheels especially shaped to take the curved tunnel floor Thus considerable time will be saved in the driving of long tunnels, for there will be no tracks to shift forward as at present.

While the rock excavator is primarily intended for tunneling work, its inventor purposes using the same principle for excavation work in rock in city building operations At the present time contractors find it difficult to remove rock in excavating sites surrounding by other buildings Blasting often proves a serious menace to adjacent buildings because of their proximity Mr App proposes using a rock excavator for removing the rock adjacent to the foundations of neighboring buildings and then blasting away the remaining rock in the usual way In this way, it is believed practically all danger will be eliminated

NOTES AND QUERIES

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents subscriptions books, etc This will greatly facilitate answering your questions as in many cases they have to be referred to experts The full name and address should be given on every sheet. No attention will be paid to unsigned queries Full hints to correspondents are printed from time to time and will be mailed on request

(14111) E A V asks Will you kindly tell me if there is any way of drilling or making holes in glass other than drilling them with steel bits? A. The only way for drilling a hole in glass is by the use of a fluid to make the drill bite the glass. The best fluid we have found consists of one and one half ounces of spirits of turpentine, one ounce of camphor gum, and three drachms of ether Keep the tip of the drill wet with this fluid and it will cut the glass very rapidly Of course there is always a risk of breaking the glass when the tip of the drill cuts through

(14112) F H W asks 1 What change actually takes place when the element phosphorous is changed from one of its allotropic forms to another? 2 Why are air waves sometimes visible over a body of water? This phenomenon has been observed over frozen bodies as well as open 3 How is the sun's heat radiated to the earth? 4 It is said that water is leaving the earth If so where is it going? 5 What causes calcium sulphide after being exposed to the sunlight, to glow when taken into the dark? A 1 Allotropic forms of an element, such as phosphorus are understood by chemists to be due to a modification of the constitution of the molecule 2 The air waves, as you term them are due to an inequality of temperature over the space where they are to be seen, thus producing an inequality of refraction of the light which passes through the space They are more easily seen with heated air than in air which is being chilled 3. The radiation from the sun is a wave motion in the ether of space A portion becomes light when it strikes an eye another portion becomes heat when it strikes a material which can absorb it 4 Water is not leaving the earth in the sense that it is going away to any other place It is being transformed into plant and animal matter, and into rocks and minerals, now as in the past. Some of this is returned to the earth again, some is not returned again as water. Rocks contain water in their composition. 5. The name phosphorescence is given to the gradual giving off of light by such substances as luminous calcium sulphide. We do not know the reason why these substances are able to thus absorb energy and later give it off as light.

(Concluded on page 675)

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Note —Illustrated articles are marked with an asterisk (*). Look for the general subject rather than the supposed specific titles of articles. Thus: "Aeronautics," "Automobiles," "Meteorology," "Panama Canal," etc., will give related articles much more quickly than by reference to the title.

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(Concluded from page 673)

(14113) R. S. asks Can water be compressed? If so, to what extent? A Water is slightly compressible At the freezing point and 1-25 atmospheres the compressibility is 525 ten-millionths, and at the freezing point and 2500-3000 atmospheres it is 261 ten millionths This gives as a result that the water at the bottom of the ocean in the deepest places say 6 miles, is about 1 20 denser than at the surface. The data for various temperatures and pressures are given in the Smithsonian Physical Tables which we send for $2 00 prepaid

(14114) W J S asks 1 To what degree does fused quartz polarize light? 2 The titles of good books on Polarization of Light. A. Fused quartz does not affect polarized light to any degree. The reason is that by the melting the three axes of the crystal are rendered equal, that is the crystalline structure is destroyed. The expansions by heat become equal in all directions and very small. For this reason the crucibles made of quartz can be set on a fire and put red hot into cold water The quartz is nearly amorphous, and does not affect light any more than glass does. 2. We can supply you with R. W Wood's Physical Optics, price $5.25, and Preston's Theory of Light, price $4 75

(14115) W S asks I would like to learn through the columns of your paper if there is anything like electricity or magnetism that affects a locomotive after a long continuous run? If so, in what way? I have heard engineers talk of engines getting tired. A little information on the subject will be appreciated A We have never known anything to lead us to think a locomotive could become magnetised or charged with electricity We have heard workmen say that the machine which they were running had become tired It would seem to mean that it was not running or doing its work so well as it should and needed tuning up Any machine needs going over and putting in shape after a long run.

(14116) J S B asks Will you kindly answer this question for me? I have always understood that any substance heavier than water would go to the bottom regardless the depth In answer to question No 14,027 J H G, Jan 22 you claim not To what depth will a submarine sink not in motion if one pound, or say ten pounds more of water is pumped into the submersion tanks than the boat displaces? A The old toy called the Cartesian Diver showed that an adjustment of the bulk of a floating body might be made by forcing water into it so that it would be just as heavy as water or a very little heavier and thus it would sink below the surface to any desired depth The diver was a little, hollow image of glass with a small hole in the tip of its tail It was placed in a tube which contained water and adjusted till it had enough water in it so that it barely floated. A piece of sheet rubber was then tied over the top of the tube If now the finger was pressed into the rubber cover the increased pressure forced more water into the image, and it sank quite to the bottom if the pressure was maintained But by careful adjustment of the quantity of water the image could be made to float at any desired depth This is the mode in a small way of manipulating the submarine so that it is submerged to a desired depth We do not know how many feet a few pounds of water would make it sink, but probably it would send it to the bottom if it were allowed to act unhindered by any motion of the boat. The Cartesian can be had from dealers in physical apparatus for schools.

(14117) E B asks Can you give me any information as to the heating qualities of different cloths? If so, please advise me which is the hottest cloth (one that consumes the most heat—and thereby heats the body) *white* cloth or *black* cloth Please designate which of the two is the coolest or hottest A In the sun white cloth will probably not get so hot as black cloth This can be tested by wrapping two thermometers, one in white and the other in the same cloth thoroughly blackened with ink, in exactly the same manner and leaving them in the sun for an hour The one which rises the highest has absorbed the most heat. This is, however, a different question from that of keeping the surface of the body at a desired temperature by clothing The interior of the body in health is always 98.4° Fahr., while we feel most comfortable when the air around us is about 68 Fahr We adjust our clothing so as to radiate our too great heat and get rid of it the best we can In summer we wear thin clothes to hasten the escape of heat. In winter we wear thick clothing to retard the escape of heat from the body; or as we say to keep us warm. Thick clothing prevents heat from passing through it. It keeps out heat from the outside, it keeps the heat in the body, which is already there. It does this largely by the air which it holds within its meshes. Air is a non-conductor of heat, and if the air cannot move away from the body, the heat cannot be conveyed away from the body Fur imprisons the most air and hence is the warmest of any materials worn for clothing Any material made thick and fluffy, so as to contain much air, will be a warm material It is neither a matter of color nor kind of material, the warmth of a material, but simply a matter of thickness and looseness of structure.

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Hupmobile

Hupmobile owners are enjoying the advantage of a mechanical service that is not only free, but available all over the United States and Canada. Each buyer receives, without extra cost, when he purchases his car, a book of coupons. These coupons guarantee to him 8 monthly inspections and adjustments of his car, and are accepted as cash in payment for such labor at any of our [illegible] authorized service stations.

WHETHER you should choose a car with four cylinders or more, cannot be settled by mere talk — which proves nothing. There is much to be said on both sides—but nothing in behalf of multi-cylinders which the Hupmobile will not be glad to answer in an actual demonstration of performance.

We take it that you want — first, high-gear flexibility, pick-up and pulling power, second, smoothness, silence, and absence of vibration at all times

On these points the Hupmobile welcomes comparison with any car, no matter how many cylinders it has, especially in its own price field

Consider, in addition, its simple reliability, and note that neither difficult nor numerous adjustments are required to keep it at its best

Hupmobile quality and economy have never been so completely expressed as in this car.

And the fact that current sales are much the largest in Hupmobile history, emphasizes its reputation as "the best car of its class in the world."

We really believe that your decision in favor of the Hupmobile is merely a matter of putting it to the performance test—which any of our dealers will gladly give you

Hupp Motor Car Corporation, Detroit, Mich.

Five-passenger Touring Car	$1185	Seven-passenger Touring Car	$1340
Two-passenger Roadster	1185		*Prices F O B Detroit*

Courtesy First—Safety for Others in Motoring

The mark of superior H *motor car service*